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# Rice Leaf Disease Detection using Machine Learning

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**ABSTRACT**

Agriculture has a critical part in the country's economic development; hence it is critical to ensure its advancement. The rice is prime meals of more than 60% of the Indians as it is the key grains in India. The reach of varied diseases in rice plant's have increased from past some years. There's a diversity of pathogens such as Bacterial, Fungal, Viral and they can damages the plant parts like leafs from above and the bottom side. The factors like light, water, temperature, radiation, atmosphere, humidity, acidity of soil and water affects natural growth of plants. It's observed that, the Rice plant's diseases are the main contributors in the reduction of production and quality of food. Recognition of such diseases may improve Production. These crop diseases are creating troubles for farmers for low output and economic loss and agriculture industry. So, it's need of ours to detect these diseases as early as possible. However, image processing backgrounds hinder the diagnosis of rice plant illnesses. A new study could use CNN to identify rice leaf disease. To diagnose rice leaf diseases, we present a 6 Layered CNN based model. We use here a novel dataset of field data and Kaggle dataset for rice leaf disease images.

Keywords: CNN, Kaggle, Leaf Blast, Brown Spot, RLDD

## I. INTRODUCTION

As world's most significant food crop, rice has always been decisive for global food security[1-4] and socio-economic stability by Naredra Pal singh et.al. (2020). Unfortunately, all rice types are susceptible to a variety of illnesses [5-7] and pests. Diseases can have an impact on both productivity and crop quality. Several illnesses commonly arise during rice farming, leading in substantial financial losses. [8-12] Furthermore, pesticides such as fungicides, nematicides, and bactericides are widely used and have an impact on plant diseases in the agro-ecosystem by Wale Anjali et.al.(2019).

Rice leaf disease forecasting (prediction) is crucial in order to maintain rice crop quantity and quality. It is beneficial to diagnose these infections early on in order to ensure that the plants grow vigorously and produce more. [13-17]Rice illnesses include bacterial blight and sheath blight, with signs such as texture rice blast, colour, and form, all of which are indicative of a quick onset and simple infection by Sethy PK et.al. (2020)

Rice disease detection is usually done manually, which is inefficient and time-consuming. Although the conventional method of mapping rice illness is rather simple and straightforward, it is possible to misinterpret comparable diseases [19-24] that have harmful effects on rice development. The Computer-Aided recognition approach has yet be widely adopted due to large ecological outcome, low precision and slow detection speed. [24-28] As a result, developing rice diseases detection's system which offers rapid and accurate rice disease decision is essential by Zhang Z et.al. (2018). The Rice infections becomes localized in the leaves and leaf diagnostics helps growers to decide whether or not to spray on their crops. [30-32]

Detecting illnesses in rice leaves with the naked eye is a difficult challenge for farmers and professionals. Recognizing the irregularity in plant with a symptom which are connected to numerous illnesses is more difficult. Recent advances in the fields of computer Aided system and Deep Learning [33-36] makes it feasible to detect the characteristics of a variety of diseases regardless of background of image or image capture conditions. A lot of publications (research) has previously been done on using CNN to detect and recognize rice leaf diseases (Convolutional Neural Network). [37-43]

With a wide range of diseases, their characteristics, complex backgrounds, and ambiguous disease signs, the challenge of real-time operation becomes more difficult. [44] To solve these issues, the current research employs a Technique called as Deep-Learning Approach based on Faster R-CNN for realtime disease recognition on rice leaves by Nagaraju M Chawla et.al (2020) and Zhang Z et.al.(2018). This work is necessary to alleviate long-term difficulties in establishment of the system for rice disease diagnose.[47]

Following are some major contributions of study:

- Because illness spot categorization is used as a basis in disease diagnosing the rice leaf, the accurateness of on-the-spot recognition has an impact in disease diagnosing the rice leaf. As a result, when finishing the detection method, the major indicator should be identification accuracy. In a deep learning approach, the majority methods for target identification include YOLO, [48] CNN [49], Faster R-CNN [50], and SSD. Furthermore, as compared to SSD and YOLOv3, Faster R-CNN [51] performs exceptionally well in detection.
- The data collection for plant leaf diseases are intended to give useful information for developing a model.[52]. To advance the resilience of CNN method, the sick Rice plant leaf image with sophisticated and standardised backgrounds must be acquired both in the lab and in the field circumstances. [53]
- In Real-time rice plant leaf disease diagnosis, CNN is deployed. Properties of infected Rice photos are automatically categorised using this proposed methodology. Three primary forms of rice leaf diseases are more accurately recognised using the proposed method. [54-56]

## II. LITERATURE REVIEW-

Early, few years before, there have some important studies in the field of Disease detection that investigate the topics related to injured Leaf, rice disease detection, paddy leaves, infection of cotton leaf, crop illness, chilli plant health.

S. D. Khirade et.al.(2015) , On splitting plant photos, many image segmentation techniques have been discussed for identifying the injured leaf portion. This work emphasises edge-based and area-based segmentation techniques.

R. Girshick, et.al.(2018), prototype scheme for the recognition of rice disease is presented in a publication, in which photographs of the diseased rice plants are taken, and the illness label is shown using image segmentation and image growth. The categorization of disease was done by means of a neural network.

In order to prevent the effects of rice plant diseases, Manoj Mukherjee et al. (2017) provided structure for processing photos of paddy leaves using histogram. By using this system, one might identify diseases early on and take prompt action to reduce productivity loss. The leaf's image was first captured, after which it was processed. Image was afterwards converted to grayscale from RGB, and then Histogram was extracted with help of MATLAB methods. Obtained pictures were provided the data for rating and classifying of illnesses.

A. Gurjar et.al.(2019) Present a research assesses a method for regularising and extracting eigen features from an image of a cotton leaf. With the aid of a constructed scatter matrix that is divided into several subspaces, the technique may detect ailments such as leaf rumple, fungal disease.

Z. Bin Husin et al., (2016) in the health of the chilli plant can be ascertained after the author worked with its leaves and underwent the appropriate processing. Their method ensures that the medications should only be used on the affected plants. MATLAB has been used to extract features from the photographs and recognise them. In this study, the preprocessing techniques include morphological procedures, edge detection, and Fourier filtering. Digital cameras were used to capture the image, and the LABVIEW programme was used to create the GUI. Tool

In a deep learning approach, the majority methods for target identification include YOLO, CNN, and SSD. CNN approach presents a structure as an alternative to existing approaches for obtaining candidate areas by Zhang X et.at. (2018). Furthermore, as compared to SSD and YOLOv3, CNN performs exceptionally well in detection.

We proposed CNN because of its high efficacy in consistently recognising illness locations.

## III. PROPOSED METHODOLOGY

The process of real-time recognition is depicted in Figure 1. To begin, the Rice Leaf Disease Dataset was compiled utilizing an internet database as well as an individual dataset that was required for the experiment. Access to the online database is easy. The Rice Leaf Disease Dataset (RLDD) [58] is manually annotated and enhanced through various data augmentation processes. After then, dataset is separated into two groups as: Training and Testing [59]. Training sets are used for train CNN [60-62], while the testing sets are used for evaluation of the system's performance. Classifications and locations of known rice leaf disease are included in the suggested work outcome. The proposed system is refer 5 Layered 2 dense CNN [63] model as shown in figure 3 below.

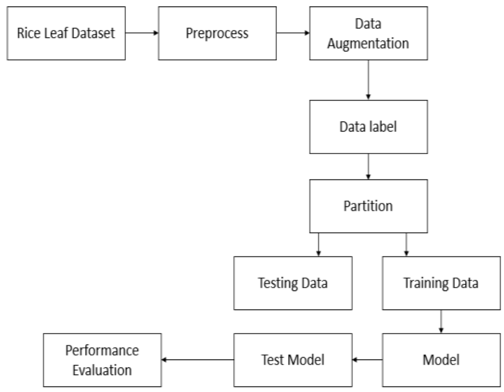


**Figure 1:** Proposed Methodology's Block Diagram

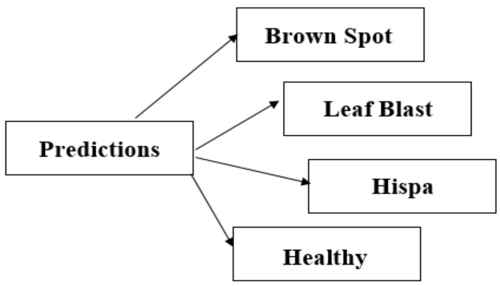


**Figure 2**: Performance Evaluation

### a. 5 Layer, 2 Dense CNN Architecture -

**Basic CNN Architecture: Explaining 5 Layers of Convolutional Neural Network**

- Convolution Layers.
- Convolutional Layer.
- Pooling Layer.
- Fully Connected Layer.
- Dropout.
- Activation Functions

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Inside neural network, a layer that is densely connected to its preceding layer means that every neuron in the layer is connected to every other neuron in the layer above it. In artificial neural network networks, this layer is the one that is most frequently utilised. Based on the results of the convolutional layers [65], a dense layer is utilised to categorise the images. The neurons in each layer of the neural network calculate the weighted average of their input, and this average is then passed through a non-linear function known as a "activation function." Therefore, utilising two dense layers is preferable to using only one. Each neuron in a dense layer receives one output from the preceding layer, which is fed to all of the layer's neurons [66]. This layer in neural networks is the most fundamental [67, 68].

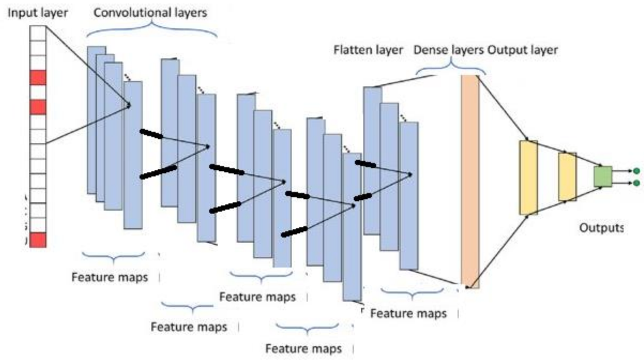



**Figure 3**- 5 Layer, 2 Dense CNN model

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau)\, d\tau \qquad \text{---I}$$

$$Z = W^T . X + b$$

$$Z = \begin{bmatrix} W_{11} & W_{21} & W_{31} & W_{41} \\ W_{12} & W_{22} & W_{32} & W_{42} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

$$Z_{2x2} = \begin{bmatrix} W_{11}X_1 + W_{21}X_2 + W_{31}X_3 + W_{41}X_4 \\ W_{12}X_1 + W_{22}X_2 + W_{32}X_3 + W_{42}X_4 \end{bmatrix} \qquad \text{-----II}$$

Whereas-

$$X = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} \qquad W = \begin{bmatrix} W_{11} & W_{12} \\ W_{21} & W_{22} \\ W_{31} & W_{32} \\ W_{41} & W_{42} \end{bmatrix} \qquad b = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

Input Data — Randomly Initialized Weight Matrix — Randomly Initialized bias Matrix

### b. Collection of Data

Diseases pattern in rice plant leave vary according with the seasons and other conditions like temperature, moisture, brightness [69], and insects. Brown leaf spot disease, for example, is most evident on maturing plants' leaves and glumes. The information gathering procedure is critical in realtime processing since incorrect data from the dataset can damage outcomes.

**Figure 3 a)**: Captured images (from created Database)

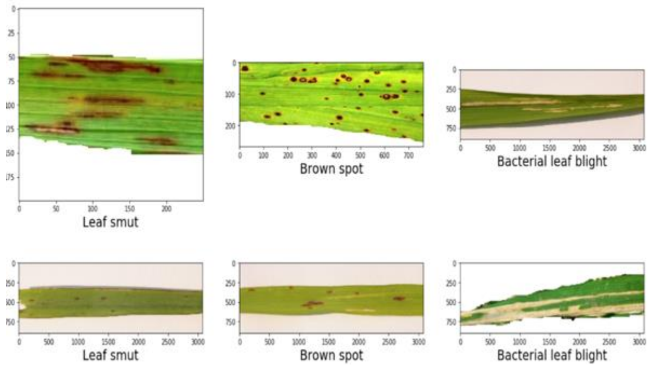



**Figure 3 b)**: Available Kaggle Database

| Leaf condition | Kaggle dataset (publicly available) |
|---|---|
| Rice blast | 500 |
| Brown spot | 500 |
| Hispa | 500 |
| Healthy | 500 |
| Total | 2,000 |
| | 2,400 |

**Table 1** Kaggle dataset

500+150 rice blast images, 500+150 brown spot images, 500 + 150 Hispa images, and 500+150 healthy rice leaf images are available from the database. A total of 2,400 photos were taken.

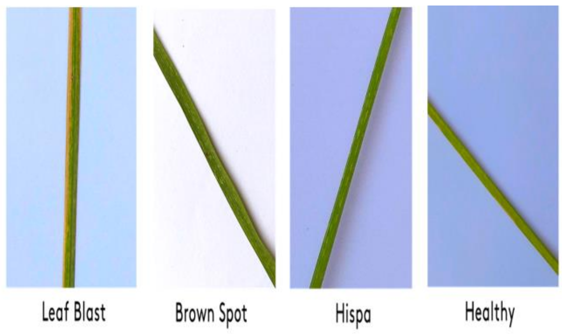
| Leaf Condiction | Images captured |
|---|---|
| **Rice blast** | **2000** |
| **Brown Spot** | **2000** |
| **Hispa** | **2000** |
| **Healthy** | **2000** |
| **Total** | **6000** |

**Table 2** Captured Images by Camera

The dataset used for our work are-

1. Kaggle Rice leaf dataset
2. Sherth Gandhinagar Rice Leaf Disease Dataset
3. UCI Machine Learning Rice Leaf Disease Dataset Dataset

**c. Data augmentation**

1) 


2) **Figure 4:** Example

The method of generation of various types of images is called as data augmentation [70]. It's important for preventing the model from fitting too tightly during the training step.

**d. Image annotation**

The classification and location of item spots within the illness [71,72]are labelled via image annotation.

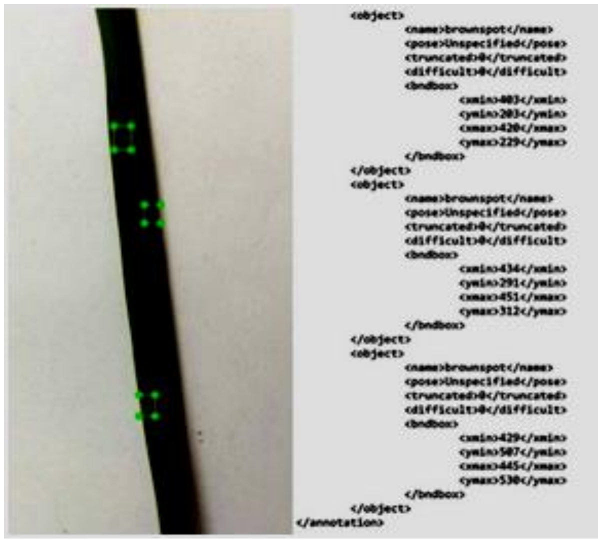



**Figure 5:** Example of Data Augmentation

**e. Process of extracting features**

Due to CNN's [73] limited explanatory nature, visualization approaches are frequently employed to better understand the CNN feature maps and determine how CNNs may learn characteristics of the many classes examined.

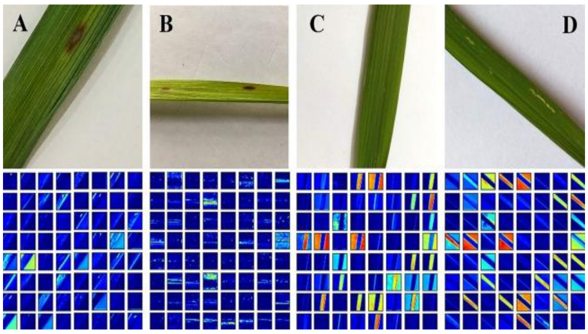



Figure 6 : Feature extraction example

f. The proposed model's loss analysis

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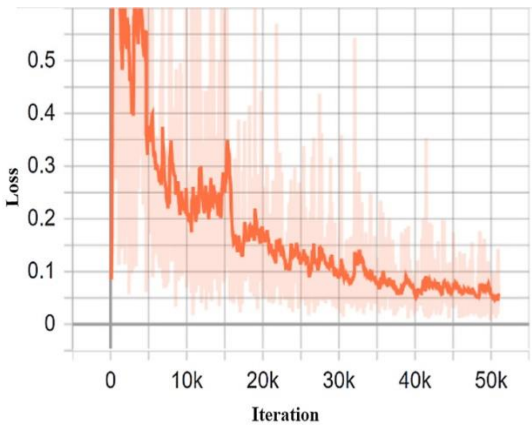


Figure 7 : The proposed system's classification loss example

The learning rate is configured as needed in the planned study. TensorBoard [74-76] is an excellent tool to view this matrix and identifying potential issues. TensorBoard updates the dimensions often and delivers result to users.

## IV. RESULTS AND DISCUSSION:

We worked on Kaggle Database (2400 images), field database (6000 images) and Sherth Gandhinagar Rice Leaf Disease Dataset (2400 images) in our suggested system. Images of leaves captured with a Smartphone camera. There were 10800 observations total. 0.0002 and 50965 are the learning rate and iterations, respectively. The results of our system is

Rice Blast 98.09 %
Brown Spot 98.85%
Hispa 99.17 %
healthy rice Leaf 99.25%

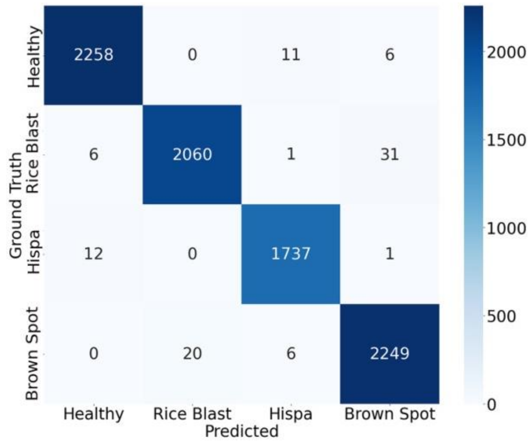


Figure 8 : Confusion matrix

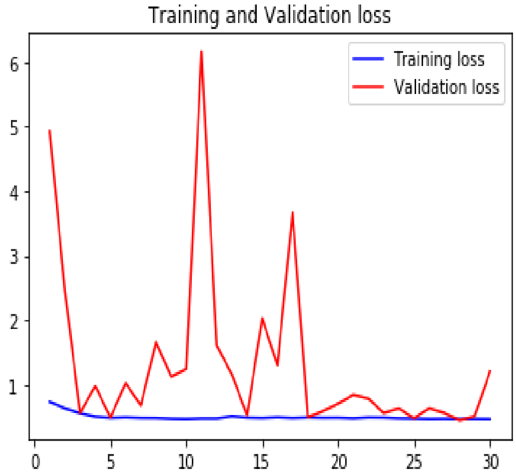


Figure 9 : Training and Validation Loss

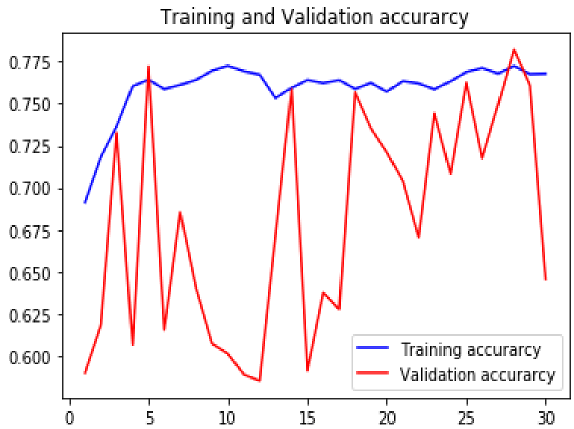


Figure 10 : Training and Validation Accuracy

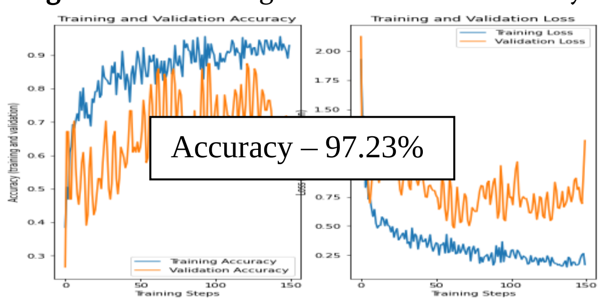


Figure 11: Training, Validation Accuracy and losses

**Accuracy of Proposed system:**

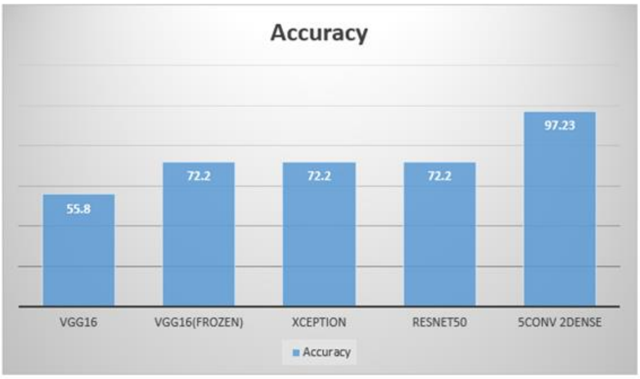


**Figure 12-** Accuracy of Proposed system

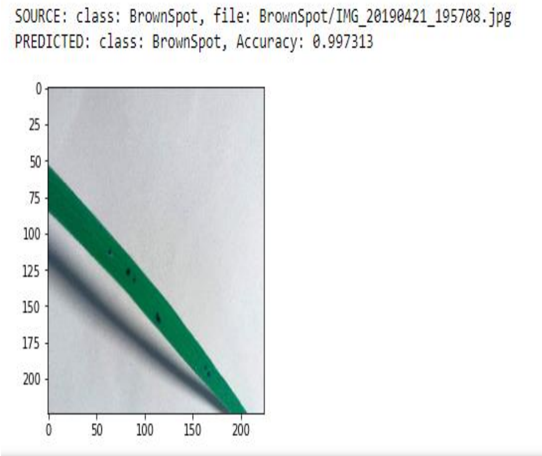


**Figure 13:** Result of leaf brown spot

## V. CONCLUSION:

In ours' proposed system, we worked on Kaggle Database, field databate, and Sherth Gandhinagar Rice Leaf Disease Dataset. The leaf images are taken by Smartphone camera. We had done 10800 observations. The Learning rate and number of Iterations' are .0002 , 50965 respectively. Our system performance is – for Brown Spot 98.85%, Rice Blast 98.09 %, 99.17% Hispa and 99.25% healthy Leaf whereas total Accuracy is 97.23%. Deep Learning Methodology is used extensively in recent years to detect plant leaf infections. From the use of CNN technology, we offer real-time rice plant infection analysis. A healthy leaf and three diseases are included in the rice leaf diseased image database. We'd like to capture rice leaf photos and merge them with a publically available internet database to improve the resilience of the suggested system. Furthermore, we've covered many image augmentation strategies to enhance our database. This method improves our proposed system performance. However, still more research will needed to separate the infected areas of leaf image. Laboratory-based recorded image is used to create the current rice plant leaf infection detection methods. More research will requires conducting in order to develop a dynamic and autonomous method for detecting large-scale rice leaf diseases. In future, further work shall be conducted on howto apply proposed method (in this paper), for dynamic detection on large scale for rice plant detection and disease. In future, it is necessity to merge intelligent Internet facilities such as Agricultural IoT and mobile's terminals to understand Live monitoring which is favorable to promote the intelligence and modernization of the agricultural industry.

## VI. REFERENCES

[1]. P. Patel SC., "Pattern recognition method to detect two diseases in rice plants.", Imaging Science Journal. 2008;56(6), pp:319–325.

[2]. Phadikar S, Sil J., "Rice disease identification using pattern recognition techniques.", Proceedings of 11th International Conference on Computer and Information Technology, ICCIT 2008; 2008. pp. 420–423.

[3]. G. Ying, L. Miao, Y. Yuan, and H. Zelin, "A Study on the Method of Image Pre-processing for Recognition of Crop Diseases," in 2009 International Conference on Advanced Computer Control, 2009, pp. 202–206.

[4]. S. Arivazhagan, R. N. Shebiah, S. Ananthi, and S. V. Varthini, "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features." 2013.

[5]. Mukherjee Manoj, Titan Pal and Debabrata Samanta, "Damaged paddy leaf detection using image processing", Journal of Global Research

in Computer Science, 2017, 3(10), pp. 07-10, 2017.

[6]. Namita Mittal, Basant Agarwal, Ajay Gupta, and Hemant Madhur, "Icon Based Information Retrieval and Disease Identification in Agriculture", 2014, pp. 1404-1664.

[7]. Zhou Z, Zang Y, Li Y, Zhang Y, Wang P, Luo X., "Rice plant-hopper infestation detection and classification algorithms based on fractal dimension values and fuzzy C-means.", Mathematical and Computer Modelling. 2013;58(3–4):pp. 701

[8]. Khairnar K, Dagade R., "Disease detection and diagnosis on plant using image processing a review", International Journal of Computer Applications. 2014;108(13), pp:36–38. doi: 10.5120/18973-0445.

[9]. S. D. Khirade and A. B. Patil, "Plant Disease Detection Using Image Processing," in 2015 International Conference on Computing Communication Control and Automation, 2015, pp. 768

[10]. Z. Bin Husin, A. Y. B. M. Shakaff, A. H. B. A. Aziz, and R. B. S. M. Farook, "Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques," in 2016 Third International Conference on Intelligent Systems Modelling and Simulation, 2016, pp. 291

[11]. Prajapati HB, Shah JP, Dabhi VK., "Detection and classification of rice plant diseases.", Intelligent Decision Technologies. 2017;11(3), pp:357–373.

[12]. Ng W. White, "Discoloration on leaves and flower-like outgrowth on stem: a new species or hormonal disequilibrium?", PeerJ, 2016; 4:e2375v1.

[13]. Girshick R, Donahue J, Darrell T, Malik J., "Region-based convolutional networks for accurate object detection and segmentation", IEEE Transactions on Pattern Analysis and Machine Intelligence, 2016; 38(1):142–158.

[14]. Zhao L, Jia K., "Multiscale., "CNNs for brain tumor segmentation and diagnosis.", Computational and Mathematical Methods in Medicine. 2016;2016(7):1–7.

[15]. Heisel S, Kovačević T, Briesen H, Schembecker G, Wohlgemuth K., "Variable selection and training set design for particle classification using a linear and a non-linear classifier," Chemical Engineering Science, 2017; 173(4), pp:131–144.

[16]. Lu J, Hu J, Zhao G, Mei F, Zhang C., "An in-field automatic wheat disease diagnosis system", Computers and Electronics in Agriculture, 2017a; 142(3), pp:369–379. doi: 10.1016/j.compag.2017.09.012.

[17]. Prajapati HB, Shah JP, Dabhi VK, "Detection and classification of rice plant diseases." Intelligent Decision Technologies. 2017; 11(3), pp:357–373. doi: 10.3233/IDT-170301.

[18]. Ren S, He K, Girshick R, Sun J., "Faster R-CNN: towards real-time object detection with region proposal networks", IEEE Transactions on Pattern Analysis and Machine Intelligence, 2017; 39(6), pp:1137–1149.

[19]. Lu Y, Yi S, Zeng N, Liu Y, Zhang Y., "Identification of rice diseases using deep convolutional neural networks." Neurocomputing, 2017b; 267(1), pp:378.

[20]. Zhang X, Qiao Y, Meng F, Fan C, Zhang M., "Identification of maize leaf diseases using improved deep convolutional neural networks", IEEE Access. 2018; 6:30370–30377.

[21]. Zhang Z, Luo L, Tan X, Kong X, Yang J, Wang D, Zhang D, Jin D, Liu Y., "Pumpkin powdery mildew disease severity influences the fungal diversity of the phyllosphere". PeerJ. 2018; 6(2):e4559.

[22]. Zhang X, Qiao Y, Meng F, Fan C, Zhang M., "Identification of maize leaf diseases using improved deep convolutional neural networks", IEEE Access. 2018; 6:30370–30377.

[23]. R. Girshick, J. Donahue, T. Darrell, and J. Malik, “Rich feature hierarchies for accurate object detection and semantic segmentation,” Nov. 2018.
[24]. Gurjar and V. A. Gulhane, “Disease Detection On Cotton Leaves by Eigenfeature Regularization and Extraction Technique.” July 2019
[25]. Gayathri Devi T and Neelamegam P, “Image processing based rice plant leaves diseases in Thanjavur, Tamilnadu”, Cluster Computing , 2018, pp. 1-14.
[26]. Khaing War Htun and Chit Su Htwe, “Development of Paddy Diseased Leaf Classification System Using Modified Color Conversion”, International Journal of Software & Hardware Research in Engineering, 2018, 6(8).
[27]. Alamsyah D, Fachrurrozi M. “Faster R-CNN with inception v2 for fingertip detection in homogenous background image”, Journal of Physics: Conference Series 2019; 1196(1):12017.
[28]. Wang Q, Qi F, Sun M, Qu J, Xue J.” Identification of tomato disease types and detection of infected areas based on deep convolutional neural networks and object detection techniques” Computational Intelligence and Neuroscience, 2019;2019(2):1–15.
[29]. M. Sunil Kumar, D. Ganesh et al, “Deep Convolution Neural Network based solution for detecting plan diseases”, International Journal of Pharmaceutical Negative Results, 2022, Vol 13, Issue- Special Issue 1, pp. 464-471
[30]. Chang WJ, Chen LB, Hsu CH, Lin CP, Yang TC. “A deep learning-based intelligent medicine recognition system for chronic patients.” IEEE Access 2019; 7:44441–44458. doi: 10.1109/ACCESS.2019.2908843.
[31]. Zarbafi SS, Ham JH., “An overview of rice QTLs associated with disease resistance to three major rice diseases: blast, sheath blight, and bacterial panicle blight”, Agronomy, 2019; 9(4):177.

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