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SURVEY ON RICE LEAF DISEASE DETECTION USING MACHINE LEARNING AND DEEP LEARNING TECHNIQUES

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Abstract : Rice is considered as one of the most important crops in India, rice crop is much vulnerable to illness. The disease that presents on plant leaves can be fungal disease, bacterial diseases or any other types of diseases. If farmers fail to identify a disease that on rice crop leaves, then it results in crop failure, it is one of the challenges that farmers confront, and as a result, it has an impact on rice production and makes delivering high-quality and quantity food to the population extremely difficult. It certainly increases the economic crisis in the agricultural field, and increase in price of rice crop. Most of farmers for their living expenses they rely upon agriculture and if it fails, they will face hard time, nowadays farmers commit suicide because of financial losses in agriculture. The manual identification definite disease is time consuming and not efficient, if definite disease is found, then farmers can take all sort of various disease control procedures in earlier stage, can also prevent from crop failure. For rice leaf disease detection, various methods and techniques are used. Bacterial leaf blight, Leaf smut, Hispa, and Brown spot diseased images are considered and segmented using Image processing technique, and important features are extracted from the segmented area using feature extraction method. These features will be used as inputs in neural network or machine learning classification algorithms that are able to detect the exact disease.

IndexTerms **– Rice leaf disease detection,Image processing, Feature extraction, Machine learning and Deep learning algorithms.**

I. INTRODUCTION

In India agriculture is the backbone, every year India produces various types of crops such as wheat, rice, pulses, cotton, peanuts, but demand for the rice is more, as it is one the most chief crop and not only the rice is consumed huge and the cultivation of rice crop is largest compare to the entire world. The disease is easily transmitted in the rice crop, and the spread of other plant diseases has accelerated in recent years, in India, an approximately 15-25 percent of crop production is lost due, weeds, pests and diseases. The variety of rice plant disease such as fungal disease, bacterial disease, viruses, these are the disease which affects the crop such way that it restricts the growth of a crop, decrease the quality and quantity of crop and has capability to damage the any parts of crop both internally and externally.

Leaf smut, Brown spot, Bacterial leaf blight, and Hispa are some of the most frequent diseases that affect rice leaves. These diseases can cause crop losses of up to 75%, and lakhs of hectares of rice are infected each year. Identifying the exact disease is challenging task for farmers, time consuming and each disease might look similar for our eyes, but they are not, these diseases differ from their own visual symptoms and it has its own texture and color. As a result, disease detection in various plant components is extremely important and useful, plays a vital role in crop life cycle, if the exact disease in not identified properly and on right time, then the disease can spread across entire crops, then on wards it hard to control and get rid of diseases not a easy task for farmers, it certainly leads to crop failure, it tend affects the availability of food in the market , and also impacts the economy of a country, especially if the country is agriculture-dependent and affects the farmer financially.

Using distinct types of data set from websites namely Kaggle, UCI Machine repository, it contains common rice leaf disease in it. The different types of deep learning and machine techniques, some techniques are images processing technique play vital role to identify and analyze image for classification purpose, machine learning classification algorithms such as Support vector machines (SVM), Random Forest method, decision tree algorithm, K-Nearest Neighbor (KNN), AdaBoost, Neural Networks, and Transfer learning are all examples of machine learning algorithms. Out of all these the Images processing technique, Convolution neural network and Transfer learning model are best suit for this kind of problem. Creating and training our model with a greater number of both diseased and not diseased images, now the model is ready to detect exact disease that present and surface of rice leaf with

more efficient and accurate way. Most of time farmers identify the disease in manual way is very time consuming, however, utilizing image processing, machine learning, and deep learning technologies, the disease can be detected automatically, where most of the burden will decreased for farmers and they can take all kind disease prevention method in earlier stage. People nowadays have a strong desire for cutting-edge technology like artificial intelligence, deep learning, machine learning, and a variety of other automated technologies. Both machine learning and deep learning techniques they play important roles in everyday life, it identifies the problem and solves the problem in more effective manner and faster way compare to human. In field of agriculture, Artificial intelligence has shown significant number of changes, in future generation most of them prefer smart farming with help of AI.

II. LITERATURE SURVEY

[1] Minu Eliz Pothen, M.Phil Scholar and Dr.Maya L Pai they have considered a dataset from UCI Machine Learning repository which consists of 120 images in all, with 40 images for each condition. An image processing technique which is Otsu's method to convert the image into machine language and then into segments, from that image segment they utilized feature methods namely "Local binary patterns (LBP)" and "Histogram of Oriented Gradients (HOG)" a feature extraction approach is used to extract only the most significant features from an image. All extracted features are used for classification, these features are combined support vector machine classification algorithm. The data was split into train and test purposes, and Linear Kernel functions, Radial Basis Functions, and Polynomial Kernel Functions were used to train the data. SVM with LBP yielded 89 percent, 90.23 percent, and 86.21 percent performance for Linear, Polynomial, and RBF kernel functions, respectively. For considering functions as kernels, the accuracy for SVM with HOG is 92.01 percent, 94.6 percent, and 89.0 percent, respectively. The accuracy for SVM polynomial kernel with HOG is the greatest among all kernel functions.

[2] Sristy Saha and Sk. Md. Masudul Ahsan proposed the random forest classification algorithm is a supervised ensemble learning technique that proposes a method for determining the disease. The system works in the way that it comprises of trees, with more trees implying a more robust forest. Similarly, the random forest algorithm creates decision trees from data models, and it just chooses the best tree to integrate them all to get a good estimate of the diseases from each one. A total of 352 photos of sample features from training data were run through the decision tree, and the model correctly identified Blast with 86.66 percent accuracy, Blight with 93.44 percent accuracy, and Brown spot with 94.54 percent accuracy, for an overall accuracy of 91.47 percent. Correctly classified categories and error classification diseases Blast, Blight, and Brown Spot are 51, 57, 52, and 8, 4, 3 correspondingly. Identification error is nearly non-existent, and performance indicators such as accuracy and recall have good scores of 0.914 and 0.916 for all diseases, respectively, which is almost one.

[3] Md Marufur Rahman and Farah Jahan proposed what are the effective feature extraction technique that improves the disease detection method, basically the images if of RGB type that is converting RGB space to HSV space with HSV has better color threshold, robust compare to RGB and segmenting the images based on only the affect area whereas the non-affected area is removed (i.e., background removal). Around there are 26 features for disease detection such as color, shape, and texture domain that can robustly describe disease affected leaf spots. The all-important features from feature extraction method is combined with Extreme gradient boosting or XGBoost model which brings significant performance improvement over other supervised learning algorithms including the original gradient boosted tree algorithm. The result gave the accuracy of 86.58%, Proper feature selection resulted in a significant accuracy improvement.

[4] S. Mathulaprangsan , S. Patarapuwadol, K. Lanthong ,D. Jetpipattanapong and S. Sateanpattanakul used deep learning algorithms, they have taken five different rice leaf disease which is different from other journals namely Bacterial leaf streak, Narrow Brown spot, Blast, Brown spot and Blight, they proposed image augmentations that is generating more number of images where with help of basic image processing and segmentation they converted images into useful features. These features are trained with VGG16, VGG19, Resnet50, Resnet101, Densnet161, Densnet169 these are nothing but different types of Transfer learning Techniques, among all the Densnet161 performed well with considered dataset of 12223 images and it gave accuracy of 97.40% and the model metrics of precision, recall, f1 score with an average score of Av 0.9884, 0.9862, 0.987.

[5] Kawcher Ahmed, Syed Md. Irfanul Alam,Tasmia Rahman Shahidi and Sifat Momen the paper proposes detecting the disease in rice leaf with effective machine learning techniques, they considered the dataset consist of three major disease are leaf smut, bacterial leaf blight and brown spot, where only diseased part images with white background as passed as input for different machine learning classification algorithm such as KNN(K-Nearest Neighbor), Decision Tree, Naive Bayes and Logistic Regression and comparing all these algorithm and choosing which algorithm gives best result, in these proposed method decision tree classification algorithm gave best result compare to all other algorithm with accuracy of 97.9167% on the test dataset.

[6] DR N Krishnamoorthy and V.R Loga Parameswar detecting of rice leaf disease with pre-trained deep convolutional neural networks namely Resenet50, VGG16, Inception V3 and the dataset contains 5200 RGB images it has been split into 70:30 for train and test. The minimum deep learning techniques are performed on images are data augmentation and image preprocessing and converting into useful feature for pre-trained neural network. Each model trained with these features, VGG16 gave accuracy of 87.08% for 15 epochs with some hyper parameter tuning technique, ResNet50 and InceptionV3 have attained accuracy of 93.41% and 95.41% respectively for 10 epochs and by several hyper parameters tuning. Among all Inception V3 performed well for considered dataset.

[7] T. Daniya and S. Vigneshwari , they considered three different diseases, namely Brown spot, Blast, and Bacterial leaf blight, are used as input images in the neural network; these images are preprocessed and image segmentation is performed for the production of segments with Segmentation Network (SegNet) the next process is extracting statistical features from segments with convolution neural network (CNN) these methods include statistical features, bacterial leaf blight, and bacterial leaf blight. The retrieved feature is fed into a Deep RNN, which is a combination of Deep RNN with the RideSpider Water Wave (RSW) algorithm for training. For improved optimization, the RSW is built with the integrated RWW in Spider monkey. The accuracy of the RSW-based Deep RNN was 90.5 percent, and the accuracy of K-fold metrics was 90.5 percent, which is practically identical to Deep RNN accuracy.

[8] Shreya Ghosal and Kamal Sarkar, a deep learning method have been utilized for finding the exact disease on rice leaf crop, can be detected with help of deep learning and Transfer learning models. They took dataset of 1509 used, the paper suggests using only Convolutional neural network the performance will be not that much effective, if the Convolutional neural is combined with Transfer learning it can perform well. Here Transfer learning techniques such as VGG-16 is used and it trained with considered dataset ran for 25 epochs, it resulted in best performance with accuracy of 92.4%, whereas CNN with fine-tuning it attained the accuracy of 74%. Hence VGG-16 can be used to detect rice leaf disease with good performance.

[9] Vimal K. Shrivastava and Manoj K. Pradhan proposed method to detect a disease on rice leaf color factors play important, it is of an image-based disease classifying method using color factor only, if identifying the right color fails then model accuracy will be decreased. There are 14 different colour spaces namely RGB to HSI, RGB to Normalized-RGB, RGB to HSV and many more, from all these colour spaces extracted four features from each colour channel led to 172 features, and extract features are combined with machine learning algorithm that is SVM classifier with polynomial order-2 kernel function has obtained classification accuracy of 94.68% on test dataset.

[10] K. Sumathi, G. Depshikha, M. Dhivya, P. Karthika and B. Priyanka detecting not only the disease on rice leaf but pesticides can severely damage crop, that is detecting pesticides that present on rice leaf with help of neural networks, nearly 144,000 insect images are taken for the experiment and images are segmented from RGB to HSV space, extracting the features from the segments and passing it as an input to neural network. Here DenseNet-121 is used as model and it gave better result and detect the infected leaves.

III. DATASET

The dataset for rice leaf disease detection is collected from different websites such as, UC Irvine Machine Learning Repository [34]. The database contains total 120 images, in which 40 images are of each disease, another dataset is also available in Kaggle name of the dataset is “Rice Diseases Image Dataset” website with total 5447 images in which 3355 images are diseased and remaining are non-diseased, whereas the dataset itself split into the section train and validate dataset, some of the diseased images are Brown spot, Hispa, leaf blast and Bacterial blight. Collecting images of major rice leaf disease from other resource.

Diseases	Number of samples
Leaf Blast	779
Hispa	565
Brown Spot	523
Healthy	1488

Fig 1: Description of Rice leaf disease dataset

Fig 2 : Leaf Blast

Fig 3 : Brown Spot

Fig 4 : Hispa

Fig 5 : Healthy plant

IV. METHODOLOGY

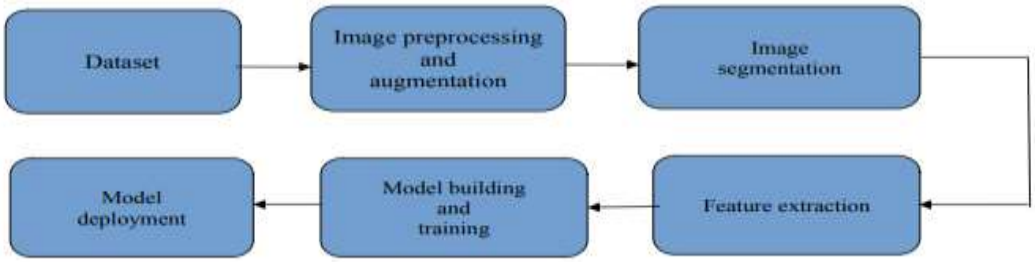

Fig 6 : Methodology used for our proposed Rice leaf disease detection using deep learning

4.1 Dataset: Rice Diseases Image Dataset has been taken from Kaggle website. Contains 5447 images has both diseased and non-diseased images.

4.2 Image Processing and Augmentation: - Pre-processing the image that is improving the image, only identifying important sectors in image whereas the unwanted parts of images are removed in this process, which is helpful in future. Image augmentation means rotating the image to certain degree, flipping image in vertical or horizontal direction and image shifting to certain place, basically generating the greater number of images, hence deep learning highly dependent on large amount of data, that is expanding the available dataset for training a deep learning model.

4.3 Image Segmentation: - diving the images into useful segments, it's a difficult task to analyse the entire image at the same time as there will be regions in the image which do not have any useful information to analyse. When image is in the form segments, the processing of image will be efficient and time consuming. In other words, image is represented in the form of pixels, image segmentation nothing but identifying the useful pixels only.

4.4 Feature extraction: - Extracting the import features from the segmented images such as texture of the image, colour of an image, different regions or shape of image. These can be obtained by using various filters, methods and extracted features is used as input for a training model.

4.5 Model building and training: - Before building a model splitting a dataset for train and test it is in the ratio of 80:20, where 80% data for training and 20% data for testing. Choosing a better model for detecting there are different deep learning techniques such convolutional neural network and transfer learning, compare to CNN model basically we will building the model with our own number of neural network layers, type of activation function used in neural network, number of neurons, different set of epochs, sometimes it either gives a good result or not, even when hyper parameter technique is used although it can't match performance of Transfer learning in few cases, keeping all in mind Transfer learning is introduced it is nothing pre-trained convolution neural network with thousand of features and weights, each transfer has fixed set of neural networks for example VGG-16 it has 16 neural network layers, ResNet-50 has 50 neural network layers and most of journals suggested transfer learning technique. Some Transfer learning model are VGG-16, VGG-19, Res Net, Dense Net, Inception V3. We will be using various models as mentioned and train our model with dataset because each transfer model performing in different way for a given dataset,

at last comparing all the model in terms for performance that is model should have good accuracy, precision and recall should consist of best score, misclassification of disease should minimum, false positive and false negative in confusion matrix should be less. If any model satisfies all the criteria will be choosing that model..

4.6 Model deployment: Deep learning or machine learning methods is not complete without model deployment, that the model should be made available for general public or clients. There are many ways the model can be deployed, using website we can deploy our with help of flask, Html, CSS or using Streamlit which is open source framework which use simple python scripts to create app, lastly model is learned, performance is calculated and deploying the best model using website.

V. RESULTS AND DISCUSSION

This survey helps to propose a model that can detect the rice leaf disease. The disease on rice leaf it's critical factor that effect the farmers crops, every year a lot of farmers suffer from damages of crops and each disease have different visual symptoms and identify the definite disease is not a easy task. We have utilized certain deep learning methods namely image processing and transfer learning methods with these techniques helps the farmers such way that it has a capability to detect the exact disease that present on crop, if the disease is found in earlier stage, then they can take all the steps to prevent and destroy that disease, this approach is cost effective, farmers simply need to upload a image in a website, so that website can detect and name that disease if the crop is been affected by disease or else it display crop is healthy and it definitely reduces much work for farmers. And also, these deep learning techniques can be used in smart farming, where their will huge hectares of rice crop, manual detection disease in such condition are not time consuming and not efficient, but with help of deep learning and automatic approach which is effective and consumes less time.

Future research on this problem using highly efficient feature extraction method to finding precise features from image, where features are majorly dependent to detect the disease. The dataset contains only four types of disease, collecting more amount of data of various known or unknown diseased images from other medium, which can add few more disease to classify, which surely helps the farmers a lot. Even Transfer learning sometimes lack from minor performance and shows some error on the data, should be improved from hyper-parameter tuning technique for better accuracy

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REFERENCES

[1] Minu Eliz Pothen, M.Phil Scholar and Dr.Maya L Pai " Detection of Rice Leaf Diseases Using Image Processing", Proceedings of the Fourth International Conference on Computing Methodologies and Communication (ICCMC 2020), IEEE Xplore Part Number, pp. 424-430

[2] Sristy Saha, Sk. Md. Masudul Ahsan "Rice Disease Detection using Intensity Moments and Random Forest", 2021 International Conference on Information and Communication Technology or Sustainable Development, (27-28 February 2021), Dhaka, pp. 166-170.

[3] T. Daniya , S. Vigneshwari " Deep Neural Network for Disease Detection in Rice Plant Using the Texture and Deep Features ", The British Computer Society, (2021), pp. 1-13.

[4] Md Marufur Rahman and Farah Jahan " An effective feature extraction method for rice leaf disease classification", Article in TELKOMNIKA (Telecommunication Computing Electronics and Control), (2021),Vol. 19, No. 2, pp. 463~470.

[5] S. Mathulaprangsan , S. Patarapuwadol , K. Lanthong , D. Jetpipattanapong , S. Sateanpattanakul " Rice Disease Recognition Using Effective Deep Neural Network", Article in Journal of Web Engineering (JWE) , (June 2021), Vol. 20_3, pp. 853–878.

[6] Kawcher Ahmed, Syed Md. Irfanul Alam,Tasmia Rahman Shahidi and Sifat Momen " Rice Leaf Disease Detection Using Machine Learning Techniques", International Conference on Sustainable Technologies for Industry, (2019).

[7] DR N Krishnamoorthy and V.R Loga Parameswar "Rice Leaf Disease Detection Via Deep Neural Networks with Transfer Learning for Early Identification", Turkish Journal of Physiotherapy and Rehabilitation, (2020), pp. 1087-1097.

[8] Shreya Ghosal and Kamal Sarkar "Rice Leaf Diseases Classification Using CNN With Transfer Learning", IEEE, (2020), pp. 230-236.

[9] Vimal K. Shrivastava, Manoj K. Pradhan "Rice plant disease classification using color features: a machine learning paradigm", Journal of Plant Pathology, (2020).

[10] K. Sumathi, G. Depshikha, M. Dhivya, P. Karthika and B. Priyanka "Insect Detection in Rice Crop using Google Code Lab", Turkish Journal of Computer and Mathematics Education, (2021), Vol.12 No.2, pp. 2328 – 2333.