Web App for Automatic Detection Classification of Rice Plant Disease Using Dilated CNN

[1]Revathy P, [2]Nandhini S, [3]Nivetha G R
[1]Professor, Rajalakshmi Engineering College, Tamil Nadu, India
[2,3] UG Students, Computer Science and Engineering, Rajalakshmi Engineering College, Tamil Nadu, India
[1]revathy.p@rajalakshmi.edu.in, [2]200701156@rajalakshmi.edu.in,
[3]200701169@rajalakshmi.edu.in

Abstract: Outbreaks of plant diseases will result in deduction of agricultural products. If plant diseases are not discovered soon, there will be more food instability. In the agricultural world, automation in identification of plant diseases based on plant leaves is a big milestone. Quick and accurate detection of plant leaf disease is essential and has a positive impact on agricultural productivity and quality. Traditional classical approaches to detect a plant disease frequently appear powerless at this moment. It is very challenging to create such automatic algorithms that detect plant diseases by optically seeing symptoms on plant leaves. With the development of automated solutions, it is now simpler to properly identify disease which helps to decrease the wastage of crops due to disease. The main objective of this project is to introduce a mechanism which will identify and prevent the crop diseases as soon as possible. It helps to strengthen the objectivity of plant leaf disease feature extraction and minimize the limitations of intentionally selecting disease spot features. The paper explains about process and algorithm we used for the accuracy enhancement of our project using Machine Learning through feature extraction and classification which is done using dilated CNN. The large dataset collected from various sources was divided into testing and training images. The accuracy of the system is measured and used for prediction in our application.

Key words: plant disease, dilated CNN, prediction, accuracy, classification, neural networks.

1. INTRODUCTION

In the Indian economic sector, agriculture plays an important role and contributes a second place in rice production. Having the finest quality is very essential forhealthy food and to attain the higher profit. Plant diseasesare one of the causes in the reduction of quality and quantity of crops.
Thus, in our project we implemented Automating detectionof Rice Plant Disease using dilated CNN. Deeplearning

Corresponding Author: *Revathy P*
Department of CSE, Rajalakshmi Engineering College
Tamil Nadu, India
Mail: revathy.p@rajalakshmi.edu.in

technique is used which successfully trains a huge amount of data and automatically learns the features. Dilated CNN is a type of convolution operation that enables the network to have a larger receptive field without increasing the number of parameters. It involves pixel skipping, so as to cover a larger area of the input. Detection of plant disease requires training and testing of data in a potentially efficient algorithm.

In this project the image dataset consists of Bacterial leaf blight, Brown spot, Leaf smut affected plants. The images are pre-processed by removing the white background.

Then these images are trained to fit the model with appropriate dilated rate then tested for an image input. Explained about Proposed system, Methodology, Results of our model in upcoming sessions.

2. RELATED WORK

The authors Sengupta, S. and Das, A.K. [1], proposed a model to detect the disease in rice leaf. Here, they have used the tecture and statistical features to identify the severity level of the disease, for which segmentation is achieved through K- Means clustering. Artificial Neural Network is used to perform the classification.

Followed by the authors Ramesh, S.and Vydeki, D.[2] proposed a model to detect the leaf disease in rice plant. In which, they used multilevel thresholding method to identify the region of segmentation and, Shape and color features were used to find the severity levels such as infection, spreading and worst stage of the diseases in rice plant.

The authors Bakar, M.N.A et al [3], proposed a machine learning model for leaf disease prediction. They have used classification algorithms such as Logistic Regression, Naïve Bayes, Decision Tree and K- Nearest Neighbour for classification, along with correlation- based extraction method for feature extraction. In this approach they have achieved 97% accuracy.

Subsequently, the authors, Larijani, M.R. et al [4], proposed a classification model for rice blast disease detection. In which, they have used the Watershed method for segmentation. Features such as shape and texture were used to classify the disease. They were able to provide the model with an accuracy of 94%. Followed by, authors Shreekanth, K.N et al [5], proposed a work to classify the diseases such as bacterial blight, rice blast and Sheath blight. The segmentation of the interested region was found with Otsu's method and the hybrid model with FCMKM and Faster R-CNN is used for the disease classification. In which, they can able to provide a classification accuracy of 98.26% for blight, 96.71 % for rice blast and 97.53% for bacterial blight.

Further, Nidhis, A.D. et al [6], proposed an improved hybrid algorithm with K-NN and K-Means in order to classify the rice plant diseases. In which, the region of interest is extracted using Otsu's segmentation method. They have also used the features such as color and shape to classify the disease. A classification accuracy of 94% was achieved. In order to highlight the effectiveness of the model, it was evaluated with different parameters such as Sensitivity and Specificity.

Similarly, Kawcher, A et al [7] proposed a model to predict the leaf diseases of paddy plant. In their field of work they used Ostu's model for segmentation, and Wavelets and texture features were used to predict the features relevant to diseases such as leaf blast, brown spot and leaf blight. To classify the diseased leaf from others they have

used the feed-forward neural network (FFNN). In which they can achieve a classification accuracy of 91%.

Followed by, Zhou, G et a [8] proposed a system to detect three diseases of rice plant, such as brown spot, rice leaf blast and bacterial blight. In his proposed method they have used the K Means clustering to group the damaged and undamaged portion of the leaf. Along with features such as color and size, centroids and proximity were also used to classify the rice plant disease. Researcher uses the automation in all fields such food [11,12,13], medical [14,15], agriculture [16], banking [17,18] and cloud computing [19,20] etc. This research only focused the agriculture area

3. SYSTEM ARCHITECTURE

Initially plant disease image dataset is downloaded from various internet sources. The acquired raw data is pre-processed by data cleaning, data augmentation etc. Data cleaning is the process of removing irrelevant and insufficient data. Techniques for data augmentation includes sample image rotation, shearing, and translation. The method of capturing the objective contents of images for retrieval and indexing is known as feature extraction. Fig-01 shows the connections between the various components of the system and indicates what function each component performs. It explains the architecture of our project.

The collected images are pre-processed which improves the uniformity among the datasets. It is computed using dilated CNN. This results in images which classifies under 3 classes. A web application is developed, which helps the user to identify the plant disease by providing an input image. It detects the disease from the model and displays the output.

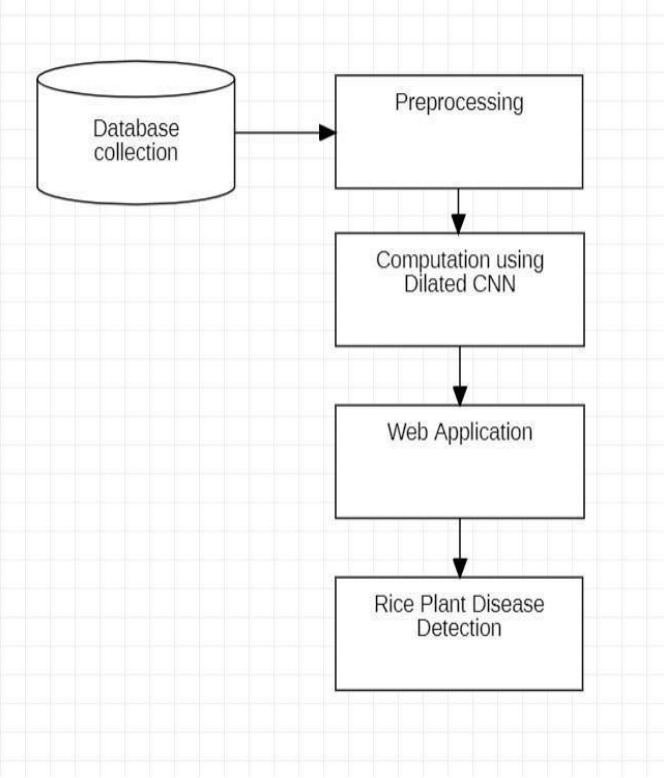

Fig 1: System Architecture

4. METHODOLOGY

4.1 Data Collection and Pre-processing

Data collection refers to the process of acquiring dataset from various sources. As no data sets pertaining to plant disease were openly available, the data collection process was carried out manually. The datasets have been collected from various sources in Kaggle. All the collected dataset are pre-processed.

This is the first step in machine learning. This step refers to the technique in which inaccurate, incomplete, inconsistent datasets are processed and the raw dataset was organized.

As we have the images dataset of various width and height, all the images are set to the minimum width and height of the image found in the dataset. Thus, all images are rescaled uniformly.

The next step performed is Data augmentation. This step refers to the technique where the training set was artificially increased by iterating between the imputation and the posterior steps. Images are augmented through shear range and zoom range. Shear range specifies the angle through which the images are sheared. Zoom range specifies the zoom-in and zoom-out range. Fig 02 and Fig 03 are the images taken before pre-processing and after pre-processing.

Fig 2: Before pre-processing

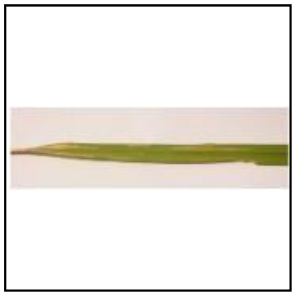

Fig 3: After pre-processing

4.2 Computation

Followed by pre-processing, the computation process is defined over our model. The dilated CNN technique has been used for the computation process. It is technique which increases the receptive field by inserting holes between elements to perform pixel skipping over the input. This technique results in more accuracy than traditional CNN model and it has significant advantage over that. This step includes introducing classifier and adding layers which is discussed in section 4.3.

4.3 Classifier

After the datasets have been collected and pre-processed, then the data will be entered into classifier model. Here, the Sequential classifier has been used and we have defined the classifier by adding convolutional and max- pooling layers. It refers to a type of classifier that processes data sequentially, in a step-by-step manner.

It is used to make predictions or classify examples. It is commonly used in machine learning and deep learning fortasks such as text classification, sequence labeling, and time series analysis. In this model, we defined 3 convolutional layers and 3 max- pooling layers, one SoftMax layer.

Convolution layer:

It takes input to performs a convolution operation in the data. During operation layer slides over the filters and input data. An activation parameter is required to be applied after the convolution operation. The convolution operation produces the output which map local patterns and spatial relationships.

Max-pooling Layer:

It works on feature map independently and divides it as pooling windows. It uses the sequential classifier and the pool size parameter determines the amount of down sampling.

ReLU Function:

A non-linear activation function ReLU is used in every convolutional layer. This is responsible for transforming the summed weighted input from the node into the activation of the node or output for that input. This ReLU function introduce non-linearity to networks output. ReLU function is used majorly in the hidden layers. It has major advantage over sigmoid activation in computation process and performs 6 times faster than that. After these layers, we flatten the data and passes it to a dense layer. Finally, outputs of these layers are combined into 3 outputclasses which are the disease class.

SoftMax Function:

In final layer, Soft Max activation function is used, Itis typically used for multi-class classification problems and for output layer. This function is widely used in Natural Language Processing, sentiment analysis, Image classification.

Soft Max functions have various advantages which combined with appropriate loss functions. Itincreases the stability and it is useful to normalize the inputvector. It transforms the raw outputs of the neural networklayer into a variety of probability distribution over the 3 input classes.

Formula for Re Lu and Soft Max activation is representedin Fig 04 and Fig 05.

$$f(x) = max\ (0, x)$$

Fig 4: Re Lu formula

$$\sigma(\vec{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}}$$

Fig 5: Soft Max formula

4.4 Web app

A web application will connect the user to our project. The data's taken from the dataset are feeded as input to our neural network model. Output of this neural networkcontains the best classifiers. These results are stored in a file which is used for testing of an input which is a rice plant disease image. For this testing, a web application isdeveloped which gets the input from the user, processes the data and displays the output to the user.

It classifies thegiven image accordingly to the respective disease class such as Bacterial leaf blight, Brown spot, Leaf smut. This web application helps the user to identify the plant disease.

Fig 06 and Fig 07 shows the web application. An infected leaf of rice plant is uploaded. The model detects and classifies the disease. The corresponding disease name is displayed in the output screen.

Fig 6: Uploading test image

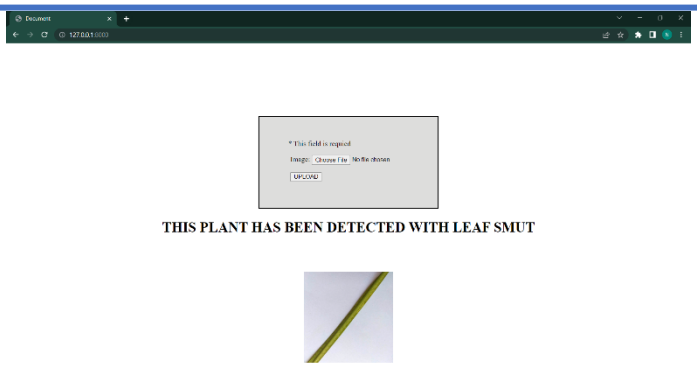

Fig 7: Output

4.5 Disease detection

The input from the web application is processed in the backend for which we used Django. This analyses the input image based on the data stored in the file. This file contains the classified output of 3 classes for the trained dataset. Users input is predicted for the disease class based on this file data.

5. CONCLUSIONS

Proper classification of plant diseases has been a difficult task in the agriculture field. It is important to remember the fact that living things cannot survive without food and thus agriculture plays a vital role in fulfilling the survival needs of our society. The developing technology can be utilized to detect various plant diseases and perform the necessary disease treatment methods at the earliest which will in turn reduce the impacts. Thus, we worked on various hyperparameters and layers in our model to bring out an efficient model with higher accuracy at better processing speed. Below table – 01 describes values of various hyperparameter changes towards our model. An increase in dropout will results in higher accuracy with slower processing speed. Thus, we got 98% accuracy when we increased the epoch and dropout parameter. The accuracy obtained through these changes was not that stable when compared to the earlier.

EPOCH	DROPOUT	LEARNIG RATE	ACCURACY
50	0.2	0.001	97%
100	0.5	0.001	98%
50	0.4	0.0001	95%
100	0.4	0.0001	97%

Table 1: Hyper parameter values

Learning rate is the next parameter which affects the model. Thus, it was decreased to increase the efficiency in learning process. This decrease in learning rate results in a good stability in the accuracy 95% but lesser than the earlier which was 97%.

Epoch defines the number of times the learning algorithm will work on the datasets. To improve our accuracy, we increased epoch for the same learning rate and dropout achieved earlier.

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