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RESNET BASED DISEASE DETECTION IN WHEAT PLANTS

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ABSTRACT

Wheat is one among the foremost developed crops in Asian continent. The crop is infected by totally different diseases at different stages of its development. It is exceptionally hard for the agriculturist's to physically distinguish the infections exactly, with their limited information. Latest enhancements in Deep Learning for the Automated image recognition through utilizing Convolution Neural Networks (CNN) models are exceptionally helpful for such issues. Infected wheat leaf image datasets are collected from the web sources and then the Transfer Learning model is used to form deep learning model for detection of diseases in the wheat plants. The proposed architecture on CNN through ResNet-50 model is trained for detecting diseases and tested on the dataset collected from wheat leaf images.
Key words: Deep Learning, CNN, SVM, ResNet 50

1. INTRODUCTION

1.1 GENERAL

Wheat is the most important food item for all human beings not only in India but also in all other countries. While cultivating the wheat plants, it affects with extreme damage. Early forecasting about the illness of the wheat plant and providing a best solution for it isa difficult task most of the times. In most of the remote areas in our country, it is difficult to find the cultivators with proper knowledge which causes severe damage to their crops which in turn makes them financially weak. In-order to avoid these types of problems, machine-controlled systems are necessary. Researchers used various machine learning strategies similar to the Support Vector Machine (SVM) and Artificial Neural Networks (ANN) to help farmers overcome their ordeal and improve accuracy in identifying plant diseases.

On the other hand, the precision of such systems is greatly reliant on the feature selection approaches. Convolutional neural networks have recently made significant advances in automatic image recognition by eliminating the requirement for image pre-processing andenabling intrinsic feature selection. Another issue is that substantial dataset for such challenges is arduous to come by. It is preferable to employ a model which has been pre-trained on a huge dataset in circumstances where the data set is quite modest. This is known as transfer learning and is used to construct a model which is used for fine-tuning to customize these final layers to make them unique to the dataset in question.

However, feature selection strategies place a big impact on how accurate these systems are. Convolutional neural network (CNNs) is a sort of neural network which makes extensive advances in recognition primarily based on photos through eradicating the requirement for the image pre-processing and enabling intrinsic feature selection. Another issue is that huge dataset for these kinds of challenges is complicated to come by. It is preferable to employ a model which has been pre-trained on a huge dataset in circumstances when the dataset size is rather small, this is said to be Transfer Learning. It may be used to produce a model which may be used as a feature extractor by stripping away the very final completely linked layer. It is used to aid wheat leaf infected dataset from the database acquired over the previous few months. Pre-trained ResNet50 network is considered (which was trained on a huge Image-Net dataset) and fine-tuned on completely linked layers with the usage of Transfer Learning in order to accommodate the leaf disease based dataset. Finally, a few error evaluations are performed and on thoroughly to define the error causes.

1.1.1 Detection of Plant Diseases Using CNN

CNN was educated with 87,848 photos of 25 plant species divided into 58 classifications, including healthy plants. Various models were trained with the most effective model providing the accuracy of 99.53% correct recognition. 54306 pictures of 14 crop types, 26illnesses, and healthy leaves were utilized to train CNN. When evaluated on different dataset acquired by a practical event, success rate dropped from 99.35 percent to 31.4 percent. The issue of disease severity is examined. So, the considerable cross resemblance amongst many photos belonging to the same category leads to further complication during detection.

1.1.2 Wheat Disease Detection using CNN

For a set of data comprising of 227 images of wheat plants having healthy, sick and snail attacked leaves, a convolutional neural network classifier is used. Alex-Net is used to train classifiers which is based on transfer learning. The accuracy of the aforementioned architecture is 91.23 percent of success rate after training, although it can only forecast if the plant is ill or not ill. The researchers gathered 500 photos of 10 distinct wheat-leaf and stem-diseases. They created a Le-Net and Alex-Net inspired architecture that scored 95.48 percent on the test set. They employed different pre-processing steps such as image re-scaling to 512*512, normalization, PCA, and whitening because the data was so small.

1.1.3 Types of wheat diseases and description of the dataset

The wheat image assortment was principally obtained throughout the previous couple of months in agricultural fields of Karnal Village (District: South to Panipat) in Sirsa, Hisar Village (District: Hisar) in Haryana, and Barnala (District: Sangrur) in Punjab, furthermore from the net. A Motorola plus and a XiaomiRedmi Smartphone camera were used to take the photos. The indications and information about the diseases were acquired from the Indian Institute of Wheat and Barley Research (IIWBR). There are only a few images available to the system to learn from. So, with the help of Keras, applied a few data augmentation approaches.

Fig 1-VARIOUS WHEAT DISEASE SAMPLE PICTURES

The set of data contains of 1649 images of the sick wheat leaves, with the six most frequent illnesses, Powdery mildew, Loose smut, Brown rust, Yellow rust, Karnal bunt and foot rot represented. Healthy leaves are represented by 507 images. Any steps to clean up the raw data haven't been taken. Poor lighting and many diseases in the same plant were among the

challenges encountered during data collection. Image pre-processing techniques like shrinking and zooming are used to try to overcome them. Because the quantity of pictures available for training CNN from the fields is limited, so use augmentation techniques such as vertical and horizontal shift, rotation and zoom that elaborate within the following Section of Implementation. Below following sections discuss about several types that have worked on a variety of wheat leaf diseases.

1. Powdery mildew

Symptoms of powdery mildew include powdery white spots that appear on the top surface of leaves and branches. A grayish-white powdery found usually on the leaves, stems, and flower parts. Subsequently, the dusty growth turns black and causes the leaves and flowers to dry out. It remains in the high hills during summer and not enough sun light and lack of air can contribute to its growth. Primary spread occurs as ascosporous and secondary from airborne conidia. The disease infects plants during periods of high humidity (not vital during rainy seasons).

2. Loose smut

The sickness is transmitted to vegetation with the aid of using wind-borne spores. The contamination remains dormant indoors in all other cases in search of healthy seeds, but the affected vegetation produces inflorescence. At this time, the flaming heads seem to be at the start of the season. Infected buds appear earlier than normal at this time. They resemble a mass of olive-black spores first blanketed with the aid of a skinny grey membrane. Once the membrane splits, the heads are powdery.

3. Brown rust

The ridge, sheaths and glumes can sometimes become decayed and show symptoms. The pustules are of circular or slightly elliptical in shape, smaller than the stem rust pustules and usually don't join together. The pathogen overcomes the summer at low and medium altitudes of the Himalayas and Nilgiris. Infections develop in the plainsof eastern India in mid-January, where they multiply and move west in March.

4. Yellow rust

Yellow pustules (uredia) appear on the leaves in the early cultivation phase. The stripes on the pustule are orange-yellow. Teliospores are also arranged in long strips and expanded. Narrow stripes are formed on the leaf blades. Pustules are also found on leaf sheaths, necks and glumes.

5. Karnal bunt

The symptom of the quadratic measure of colored Karnal is usually difficult thanks to the fact that the incident of the accumulations, because infection in a particular head islow and is difficult to distinguish.

6. Foot rot

The illness mainly takes place when seedlings, roots and rootlets turns to brown in colour. Seedlings come to faded green and feature scrawny growth. Fungus produces sporangia and zoo-spores and oospores.

1.1.4 1.1.4 SUPPORT VECTOR MACHINE (SVM)

Support Vector Machine (SVM) is a supervised machine algorithmic training program. It may be used as a classification or a regression for each analyzed data. SVM algorithm trace every single piece of information as some measure in the N-Dimensional house value ofevery single value of a specific coordinate being a feature. Next, it carries out the classification of two classes for differences by finding the hyper plan.
SVMs are merely classified as individual observing coordinates. The SVM classifier may bea boundary that most segregates the 2 categories.
The SVM classifier is easier to get a linear hyper plane between these categories. However other burning issue that comes up is: whether it wants to perform manually to get a hyper plane or to use this function to get a hyper plane. The core of SVM may be a performance that takes an occasional dimensional entrance house and transforms it into a much larger dimensional space, e.g. it converts the indivisible inconvenience into a separable drawback. It's principally helpful within the problem of nonlinear separation. In a very nutshell, it will do some terribly advanced information transformations so ascertain the strategy to separate the supported information from the labels or outputs you defined.

Fig 2-SVMFOR PLANT DISEASE DETECTION

1.1.5 CONVOLUTIONAL NEURAL NETWORK

A convolutional neural network (CNN) is one of the types of artificial neural network. It is useful in image recognition and processing which is specially designed for processing of data of pixel form**.** It has multiple layers to process the data and extract important features from the grid like arrangement.
CNN saves a lot of time and also reduces errors. Since, it doesn't need more parameters for learning the characteristics of image filters. The main purpose of the CNN algorithm is to extract image features without losing the data it represents. CNN is based on neuroscience findings and is made up of artificial neurons.
Usually for image processing through CNN, if an image is given then it takes pixel values as data and picks some visual features. It points out the pixel values of colors for the activation function.
At initial stage it takes the edges of the picture and sends it to detecting the corners and color groups of the image. Then the image defined is passed to the next layer for pooling, this cycle continues until the image is predicted.
The decreased size of the image gives finite definition which makes max pooling occur. It only reveals the most relevant features for activation function features for soft max layer for dense process.

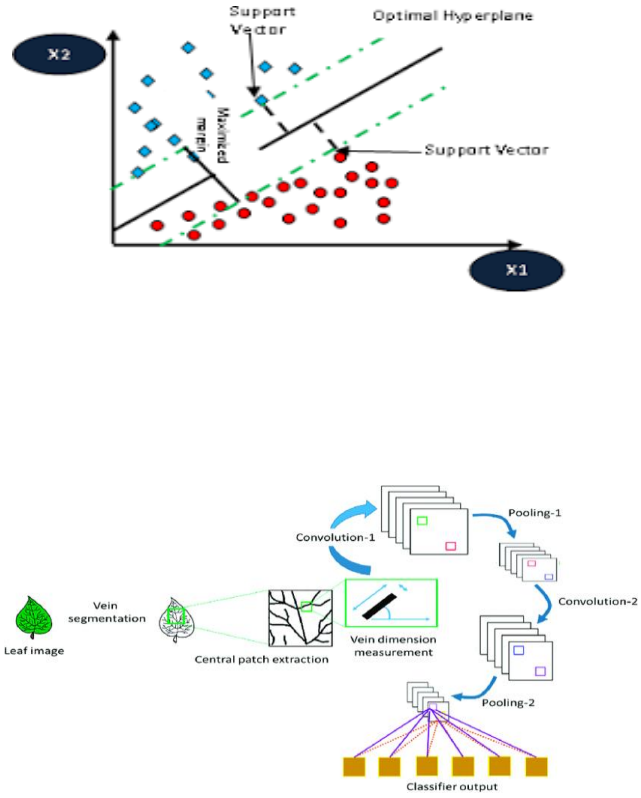

Fig 3- Plant Disease Detection Using Cnn

1.2 PROBLEM DEFINITION

To improve the process of predicting through Res-Net 50, it is easier and better to know about the type crop which is infected in a short period of time with better prediction and with few side effects.

1.3 OBJECTIVES

1. To create a deep learning architecture for identification and detection of wheat plant based diseases with the usage of Res-Net 50 as a

predefined neural network.

2. Input data is termed as an image and it's processed and augmented for testing and training of the image to predict the disease. The operating procedure for parsing is from Front-End to Back-End.
3. Convolution is applied on the RGB image to get matrix formation and pooling is applied on it to reduce the spatial distance and dimensions in feature maps. Then a classified output is obtained for prediction.

2. LITERATURE SURVEY

2.1 SURVEY ON PLANT DISEASE

R.R.Atole, D. Park (2018) [1] investigates the usage of a deep convolutional neural community with inside the category of rice plant life consistent with their fitness repute primarily based totally on pictures in their leaves. Three-magnificence classifier acts for normal, diseased, and snail-infested plant life become constructed the use of switch gaining knowledge from an Alex-Net deep community. The education and checking out datasets havebeen created by the usage of pictures from rice fields.
The network achieved 91.23 percent of accuracy with the usage of stochastic gradient descentwith a minimum batch size of (30) thirty and an initial learning rate of 0.0001. To depict the various classes, 600 photographs of rice plants were used in the training and testing of the datasets. The training and testing dataset was created using images from rice fields throughout the district.

P. Konstantinos Ferentinos (2018) [2] researches about convolutional neural network models that were engineered utilizing deep learning methodologies to observe, diagnose plant-leaf diseases, exploitation foliage photos of healthy and morbid plants. Models were trained using 87,848 photos from the general public domain, including twenty five distinct plants in fifty eight totally different categories of [plant, disease] try, furthermore as healthy plants. several model architectures are shaped, with the most effective detective working the right pair [plant, disease] with a success rate of 99.53% (or of healthy plant).
Since the Alex-net is not deep, it struggles to scan all the options, therefore, it is poor in performing functioning models. It needs a massive memory. Training and testing of information causes over-fitting and results in provides poor results.

Y. Lu, S. Yi, N. Zeng, Y. Liu, and Y. Zhang (2017) [3] studies about diseases and pesticide in the plants can be detected early and accurately, reducing economic losses. It can help farmers keep track of when and how much medicine they're giving out. Thanks to latest advancement in deep learning (DL)-based convolutional neural networks, researchers have been able to significantly improve the accuracy of picture classification (CNN). It offers a deep learning-primarily based method for detecting illnesses and pests in rice vegetation the usage of pictures taken in a real-international context with many backgrounds.
On the massive dataset of rice illnesses and pests, which includes both inter-class and intra- class heterogeneity, we experimented with multiple state-of-the-art convolutional neural networks. The results reveal that a deep convolutional neural network can efficiently detect and distinguish nine classes of rice diseases and pests, including healthy plant classes, with the better accuracy of 99.53 percent in the test set.

V.Singh, A.Misra, (2017) [4] study proposes an image segmentation technique for detecting and classifying plant disease automatically. It co-jointly provides a summation of the many disease classification systems which may be used to discover disease of a plant leaf. Image segmentation might be a key side of illness identification in the plant leaf disease and is completed using the genetic algorithm.
The importance of agricultural output to the economy cannot be overstated. It is one of the reasons why, because diseases in plant is a natural occurrence, disease detection in plants is critical in the agricultural sector. If this region is not properly cared for, it can affect the plants seriously, impacting product quality, quantity, and productivity. For example, little leaf disease is a deadly ailment that affects pine trees in the United States. Plant disease detection with an automated method is helpful as it reduces the amount of monitoring necessary in big crop farms and detects disease symptoms at an initial stage, i.e. when they first appear on plant leaves.

Y. Es-saady, T. El Massi, M. El Yassa, D. Mammass, and A. Benazoun, (2019) [5] studiesabout machine vision methodology for mechanically recognizing plant leaf diseases through images. The urged approach is predicated at the serial mixture of two SVM classifiers. The number one classifier makes use of shade to purpose the photos; at this point, it thinks that diseases of comparable or same colour belong to identical class. Supported form and texture qualities, the second classifier is used to discriminate between the categories that havecomparable colors.

P. B. Padol and A. A. Yadav (2016) [6] studies SVM classification technique. The pathological region is a segmented victimization according to cluster by K-means. Victimization PCA-Technique form options of unit for extracted area and victimization based colour mainly on grid moments by unit of the area to extracted colour options. Thefirst conversion of the RGB image to HSV colour areas has been completed.

Huerta-Espino J., et al (2017) [7] researches about high levels of pathogenic diversity to express the race analysis on P. Triticina. Mutation and modification on genes of a plant for exotic races with frequency. If a particular resistance genes of a plant is used, then tests can be conducted in particular with appropriate genotypes at that plant. The race specific resistance genes utilize the effective life span on the varieties through the predominance of a race. The goal of the literature review is to compare the different technologies implementedin detection of plant disease through CNN.

Kamlesh Golhani , Siva K. Balasundram,, Ganesan Vadamalai , Biswajeet Pradhan., et al(2017) [8] studies about Convolution Neural Network (CNN) procedure is available in the marketplace to approach hyper-spectral data, with a unique pressure on sickness findings. At first, we provide an assessment of the CNN mechanism, models, types and classifiers that use absolutely one-of-a-kind algorithms to method hyper-spectral statistics. Then there is a tendency to focus on this country of imaging and non-imaging hyper-spectral statistics for initial illness findings. There may be a tendency to introduce NN strategies for immediate improvement of SDI.

2.2 SUMMARY OF LITERATURE

1) In case of rice farming, it can be constructed by supporting and applying DIP (Digital Image Processing) inside the image it detects the rice plant diseases, which is supported by the observations that nearly the entire disease area unit is manifested within the design of the leaves and on the visual choices of the plant.

2) Alex-Net may be a deep, convolutional neural network which is designed to classify one. CNN modes designed on VGG16 or specific comparable architectures are spectacular. These modes are not suitable for cellular gadgets as they are of biglength having a widespread form of parameters.

3) To remedy this drawback, a propensity to suggest an alternative CNN design to have particularly stacked CNN that exploits 2 degree education to reduce the size of the version significant where at consistent time retaining excessive category accuracy.

4) Genetic algorithms belong to the natural manner algorithms that generate solutions to optimize the issues. RGB image is employed for input. SVM classification technique is considered.

5) The pathological region is segmented victimization according to cluster by K-means. Victimization PCA-Technique Form options unit of the extracted area and victimization based on colour mainly grid moments the unit of the area of the extracted colour options.

ANALYSIS ON PLANT DISEASE DETECTION

S.NO	TITLE	DESCRIPTION	KEY FINDINGS
1	A Multiclass Deep Convolutional Neural Network Classifier for Detection of CommonRice Plant Anomalies	A three-tier classifier is carried out to represent normal, unhealthy, and snailinfected vegetation through switch mastering from an Alex-Net deep network.	Multispectral high altitude images are not used. Leaf Blythe, Brownspots and other rice disease abnormalities are not included. Alex-Net is not very deep in learning so it may struggle to scan allthe features resulting in poor output.
2	Identification of Rice Diseases Using DeepConvolutional NeuralNetworks	Deep learning methods for identifying pests and diseasesof rice through context of pixel data. Inter-class and Intra-class diseases have been extinguished.	CNN models based on ResNet inception and Xception architecture arenot included for accurateresults. Automated disease recognition for plants with the incorporation of its soil data and weatheris not yet developed
3	Detection of Plant Leaf Diseases UsingImage Segmentationand Soft ComputingTechniques	Deep Learning technique segmentation is used to detectthe diseases of plant leaf by disease classification system. Plant disease can be identified at an early stage	Hybrid algorithms are not included for classification of the image given. Limited plant diseases are identified as the related plant diseases are appliedin system.
4	Automatic recognitionof plant leaves	SVM classifier is used for recognizing the plant	Neural-Networks or

	diseases based on serial combination oftwo SVM classifiers	diseasesand names through texture qualities. KNN NB and SVMare tested for better classifier of plant detection.	discriminate analysis arenot included in plant classification. It is a system based on parallel combinations which is a time taking process for training and testing on large datasets.
5	SVM classifier basedgrape leaf disease detection	It has K-means clustering segmentation for victimizing the pathological image dataset and feature extraction.SVM classification is used for leaf detection.	Combination of algorithms such as fusionclassification is not included. Embedded system for spraying of fungicide mixture is not designed. It takes more amount oftraining time for a largedataset.
6.	A review of neural networks in plant disease detection using hyper-spectral data	Convolution Neural Network(CNN) procedure is available in the marketplace to approach hyper-spectral data,with a unique pressure on sickness findings. At first, weprovide an assessment of the CNN mechanism, models, types and classifiers that use absolutely one-of-a-kind algorithms to method hyper- spectral statistics.	CNN has not been evaluated for SDI whereas there may be a prospect to exempt a few instructions to get conceivable improvement. These procedures are shipped victimization CNN's earlier than the occasion of companion SDI. It requires high cost to perform CNN on SDI asit requires high initial investment for irrigation system compared to thatof other.

Table-1 ANALYSIS ON PLANT DISEASE DETECTION

PROPOSED SYSTEM

3. PROPOSED SYSTEM

3.1. PROPOSED SYSTEM

A Deep Learning technology that automatically recognizes images with the use of Convolutional Neural Network (CNN) with transfer learning (ResNet50) models is proposed for detection and identification of wheat plant diseases. Res-Net 50 model is introduced for pooling and classification of image data which is a predefined neural network model. Architecture on CNN through ResNet-50 model is trained for detecting diseases and tested on the dataset collected from wheat leaf images. By this proposed system, Wheat plant disease detection and its type be easily defined.

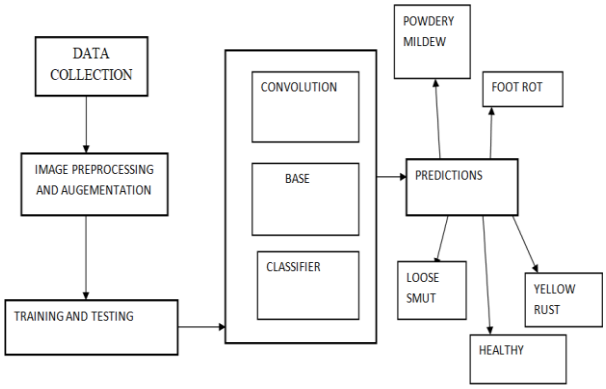

Fig 4-ARCHITECTURE

3.2 ARCHITECTURE OF THE PROPOSED SYSTEM

In the proposed system, first an image is collected as an image dataset and is sent for processing. Image processing is the next step for the detecting the image which is rotated and then the colour pixel data of image
is collected. At this step itself augmentation of image is done through which image duplicates are created for testing.
At next process training and testing of the data takes place. Training of image takes three steps at
Step 1- Convolutional of the image takes place. Through this process the image pixel data is converted into matrix form.
Step 2- After convolutional of the image, pooling of the matrix is done. In this process the matrix is reduced to finite feature values for classification.
Step 3- At the last stage the SVM classifier is used for the image feature extraction.

Then the image is tested through predictions and the disease of the wheat plant is detected.

IMAGE PRE-PROCESSING

Image pre-processing is about steps taken for the formation of an image before its model training and interference. It's not limited to colour correction and resizing. It decodes the JPEG file formatted image to the RGB grids for pixel data between 0-225.

AUGMENTATION

Image augmentation is a process of altering the existing data to create more data models before the training process. It is also known as the artificially expanded data models from the available data sets.

CONVOLUTIONAL

Convolutional is an application of a filter to an input for the activation results. Repeated application of the same filter to an

input data for the map activation results leads to feature map. Convolutional is first layer extract features from the dataset. It preserves the relationship between the pixel data through learning image features.

POOLING

It is used for reduction of spatial size in matrix after convolutional. It also reduces the parameters and computation in network. It operates each feature map independently.

3.3. ALGORITHMS

Res-Net50

When operating with deep convolutional neural networks to clear up a trouble associated with laptop vision, gadget mastering professionals have interacted in stacking greater layers. These extra layers assist clear up complicated issues, because one of the kind layers might be skilled for various responsibilities to get exceptionally correct results.

Even though Res-Net50 structure is primarily based totally on Res-Net34, there is one predominant difference. In this case, the constructing block changes right into a bottleneck layout because of its worries over the time taken to teach the layers. This used a stack of threelayers as opposed to the sooner.

Therefore, every 2-layer blocks in Res-Net34 changes with a three-layer bottleneck block to form the Res-Net 50 structure. This has a great deal which provides better accuracy than the 34-layer Res-Net model. The 50-layer Res-Net achieves an overall performance of three.

ALGORITHM

1. Step 1: First, take an input image and convert the JPEG format image to a RGB-D image and proceed for convolution process with 7x7 matrices.

2. Step 2: The next step is for pooling the matrix for reducing features and reduce the parameters and amount of computational time for feature maps. It gives a image size of 56 pixel

3. Step 3: Continue the process of convolution till the image pixel size reaches to 7 and pooling is done to reduce the matrix to feature map to 2x2.

4. Step 4: Finally, fully connected (FC) 1000 layer is processed for classification outputwith the help of soft-max.

4. CONCLUSION

Res-Net 50 model improves the performance in the detection of wheat plant-based diseases which was previously unsatisfactory while using VGG16, Alex-Net on such a large dataset. A Convolutional neural network is considerably slower because of associate operation like maxpool. Transfer learning with fine-tuning deals the error formation on detecting the wheat plant diseases. Pooling is done on feature extraction of pixel data for reducing spatial matrix size. Wheat plant disease through SVM classifier and Res-Net 50 gives effective prediction with accurate results. Automated image processing takes place for the image processing on given image dataset. By proposing Res-Net 50 model, it increases the rate of detecting wheat plant-based diseases.

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