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PLANT DYNAMICS: Triticum Infection Disclosure

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Abstract

Agriculture being the pillar of the economy for a developing country like India has a vital role in the survival of living beings on earth. Wheat is the most widely consumed grain on the planet. Deep learning is an evolving technology that is having a significant effect in the field of agriculture, assisting farmers in modernizing their operations. One such application is the identification of plant diseases using image classification which is necessary for long-term agriculture sustainability. Wheat plants are susceptible to a variety of fungal diseases. Hence early identification of diseases of crops like wheat and rice that are staple food of people in many countries is critical. Using deep learning algorithms such as CNN, this proposed system aims to predict wheat diseases. We are introducing a deep learning-based model for image classification to predict wheat diseases. Previous approaches used machine learning algorithms for a general dataset that included all types of crop diseases. To achieve better precision, we built our own dataset and combined it with existing similar datasets to account for 4 major classes of wheat diseases. The dataset consists of 700 images of wheat plants. Based on the input, our system determines if the plant is healthy or diseased so that precautionary measures can be taken to prevent losses in wheat cultivation, which could lead to food shortages.

Keywords: *Wheat disease detection, CNN, Tkinter, Image processing, Deep learning*

1. Introduction

Food is the most essential and basic necessity for human life. Food production is in high demand in many parts of the world. India is the land of diversity not only in culture, but also in food. India is an agricultural country. Enormous number of Indians live in the remote and rural areas , where the source of revenue is essentially dependent on agriculture (approx. 70% of the population). This shows that the Indian people mostly rely upon crop cultivation. Key factors that are hindering the yield of crops are the infectious diseases these crops are subjected to. In traditional agricultural processes a farmer uses his own observations to classify and diagnose plant diseases, which takes more time and requires constant monitoring; this might turn out to be highly expensive, time-consuming and increasingly difficult for huge plantations. Therefore, several strategies for detecting diseases are being developed using machine learning and deep learning algorithms, computer vision, and image processing. Wheat cultivation is an important asset of Indians. Triticum is the scientific name for wheat. Identifying ailments from pictures of wheat plants is an exciting area of research in the computer and agriculture fields. Various diseases affect wheat plants, some of them are Wheat Streak Mosaic, Fusarium Head Blight (Scab), Leaf Rust, Tan Spot, Wheat Soil-borne Mosaic, Black Chaff, Crown and Root Rot. Medical care of diseased wheat plants was performed manually in the beginning; this would require immense time and effort. Hence, image processing is employed in wheat plant disease classification. It involves steps like image preprocessing, image segmentation, feature extraction, and CNN classification. This paper emphasizes the wheat plant disease detection which includes 4 major diseases: leaf-rust1, stem-rust, Black-chaff, Bacterial-mosaic. The latest disease detection technique consists

primarily of specialists' optical inspection continuously, which allows for the recognition and detection of certain diseases, which ranges to terribly high prices once wheat farms are huge. In similar conditions, the proposed methodology is useful for monitoring large fields of wheat. And it makes it simpler and cheaper to automatically identify the diseases by clearly looking at the symptoms on the wheat plant. Fungal disease, viral disease, and there are so many others which affect the crop. Image processing, and Deep learning techniques are extensively explored for this purpose. The image recognition process comprises steps such as image preprocessing, segmentation, attribute extraction and pattern recognition. One of the most important phases is image segmentation, and the precision of the segmentation has a significant impact on the efficiency of attribute extraction and recognition accuracy.

II. Motivation

Small improvements in farming methods may have a significant impact on production and profitability. But, due to differences in local circumstances, providing farmers with uniform agricultural assistance using new technologies has become difficult. Because of the high costs of working in agriculture, traditional and few other traditional methods have a negative impact on productivity. Hence enabling farmers of our country to take complete advantage of the new technologies to improve yield is the thought behind our work. One major application is disease identification and providing cure and further medical assistance for crops. This project helps in prediction of wheat plant diseases in an early stage and helps farmers to take required care to reduce the infection.

III. literature survey

Santhosh Kumar.S and B.K.Raghavendra [1] have proposed a system which uses image processing techniques where small flaws could be corrected and image dimensions might be modified.It takes time to process images. As a result, CNN overcomes this by generating data more quickly.

Sammy V. Militante and Bobby D. Gerardoij [2] used deep learning and computer vision structure to evaluate 32 unique plant patterns and defects. This method has several layers then the training process takes a lot of time if the computer doesn't consist of a good GPU.

Melike Sardogan and Adem Tuncer [3] have developed a methodology that makes use of the Learning Vector Quantization technique to fetch 500 unique attributes acquired from the actual images. There is a reluctance for being spatially variable to the data input. CNN is used to accomplish this.

Sumit V and Aarjun Dixit [4] have designed a system that uses clustering, machine learning methods and segmentation. This model mainly uses a Support vector machine which is not very appropriate for big datasets and also data with more noise.

Bin Liu and Cheng Tan [5] used generative adversarial networks which are very tough to train and we need to have a variety of data to check if the system is working properly or not. We can overcome this disadvantage by using CNN which is easier to train as compared to generative adversarial networks.

Methodology

In the proposed system, the plan of fortifying a model for recognition of diseases of the wheat leaves into several steps from collecting sample images to train the model. The sample images of some substantial wheat leaves diseases are discussed below.

A. Categories of wheat leaf diseases used in proposed system

1. Leaf-rust

Fig. 1 represents one of the foremost diseases disturbing wheat yield production, it lowers the radiation capture of the leaves, in succession reduces the photosynthesis rate and scales down 70% of plant growth.

Fig. 1 Sample images of Leaf rust

2. Stem-rust

It is a fungal disease as shown in Fig. 2 is caused by Puccinia graminis. The fungus sustains on host plants, escalates quickly over large distances by wind and takes up nutrients from the plant tissues that decreases the yield by 90%.

Fig. 2 Sample images of Stem rust

3. Black-chaff

It is a disease caused by the bacterium Xanthomonas campestris pathovar, in wet weather conditions it expands faster creating the darkening of leaf tissue and black/brown spots on the fungal infected lesions as shown in Fig. 3.

Fig. 3 Sample images of Black chaff

4. Bacterial-mosaic

This disease as shown in Fig. 4 is caused by the bacteria Corynebacterium michiganense that spreads over the entire leaf surface causing small yellow spots on it. This has consequences on soil enzyme activity which hinders the metabolic growth of the plant.

Fig. 4 Sample images of Bacterial mosaic

5. Healthy-leaves

Leaves that are completely healthy without any infections are considered for healthy leaves set as shown in Fig. 5.

Fig. 5 Sample images of healthy

B. Steps in Image processing

The images, which are captured from cameras, have a lot of noise as well as poor background, therefore affecting the accuracy. Therefore, the selected images will be processed and changed into appropriate ones. The complete description of image processing steps are explained below.

1. Image-acquisition: It is the initial step in the workflow series to handle the images before processing. It is the operation of fetching completely unprocessed images from different physical sources like cameras and transforming them to arrays of numerical data which can be handled by the computer.

2. Image pre-processing: In this step where reshaping and resizing is done, removes the noise so as to upgrade the image, it vanquishes the unwilling distortions and intensifies the important characteristics of the image.

3. Image segmentation: It is the procedure of dividing the image into many segments and extracts only the objects required for further steps.

4. Feature extraction: In this step we take out important features for dimensionality reduction from the image as required by the project so that processing of the large data will become easier.

5. Detection and classification: For classification of disease we are using CNN algorithm which accepts images as input, processes them to differentiate one from the other and classifies according to the category mentioned, along with accuracy.

C. Steps in CNN algorithm

After the first phase, which is image processing where the dataset is ready for training, we split the dataset into training and test dataset and train using a deep Convolutional Neural Network (CNN) to discover and categorize the wheat leaf diseases. The complete view of the steps in CNN are explained below along with Fig. 6.

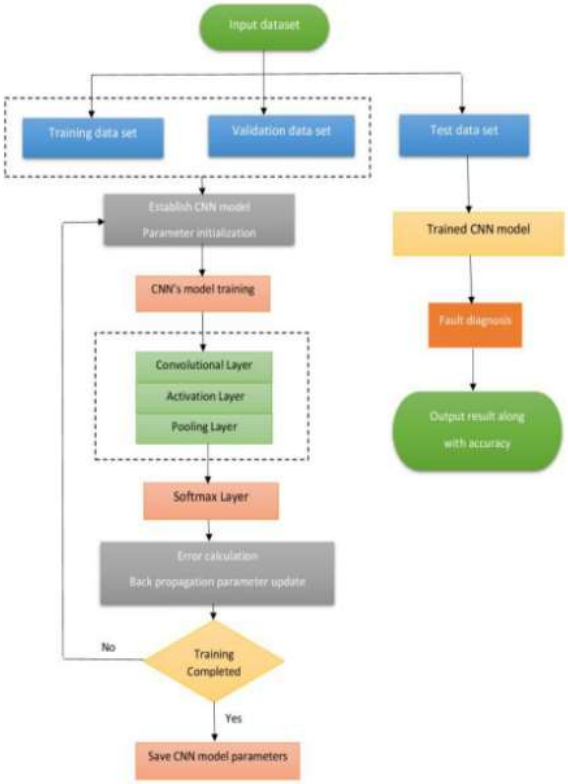

Fig. 6 Data flow diagram for CNN

1. Convolutional-layer

Takes the input image, applies a number of filters, according to what is learnt in the past it tries to label the input signal and the resulting output signal is sent to the next layer.

2. Pooling:

The inputs from the convolutional layer can be smoothened by scaling down the image variables to avoid the noise,reduces computational time and checks overfitting, this can be achieved by taking the maximum value in the filter region which is called max pooling.

3. Flattening:

This is a simple layer which flattens the output from the pooling layer into a sequential long vector, and functions as the input for the next layer.

4. Fully-connected-layer:

This connects the neurons of one layer with the neurons.

3. Results and Discussion

To begin with, photographs of healthy and diseased plants are composed and pre-processed. These images are then stripped of attributes such as size, colour, texture and fed to the model. The model then performs the wheat leaf disease detection using CNN as shown in Fig .8. This framework uses 5 levels of CNN that is input layer, convolution layer, pooling layer, fully connected layer and output layer and for the image processing technique we use the open cv method to get accurate results and for better performance.

For achieving the higher accuracy, we have created our own dataset along with existing related dataset to consider all kinds of diseases occuring for the crops. We have considered 700 images and used 500 images for training and 100 for testing and 100 for validating our model. We have trained our model for 50 epochs and we achieved 96% of accuracy as shown in Fig .7.

Fig. 7 Model Accuracy

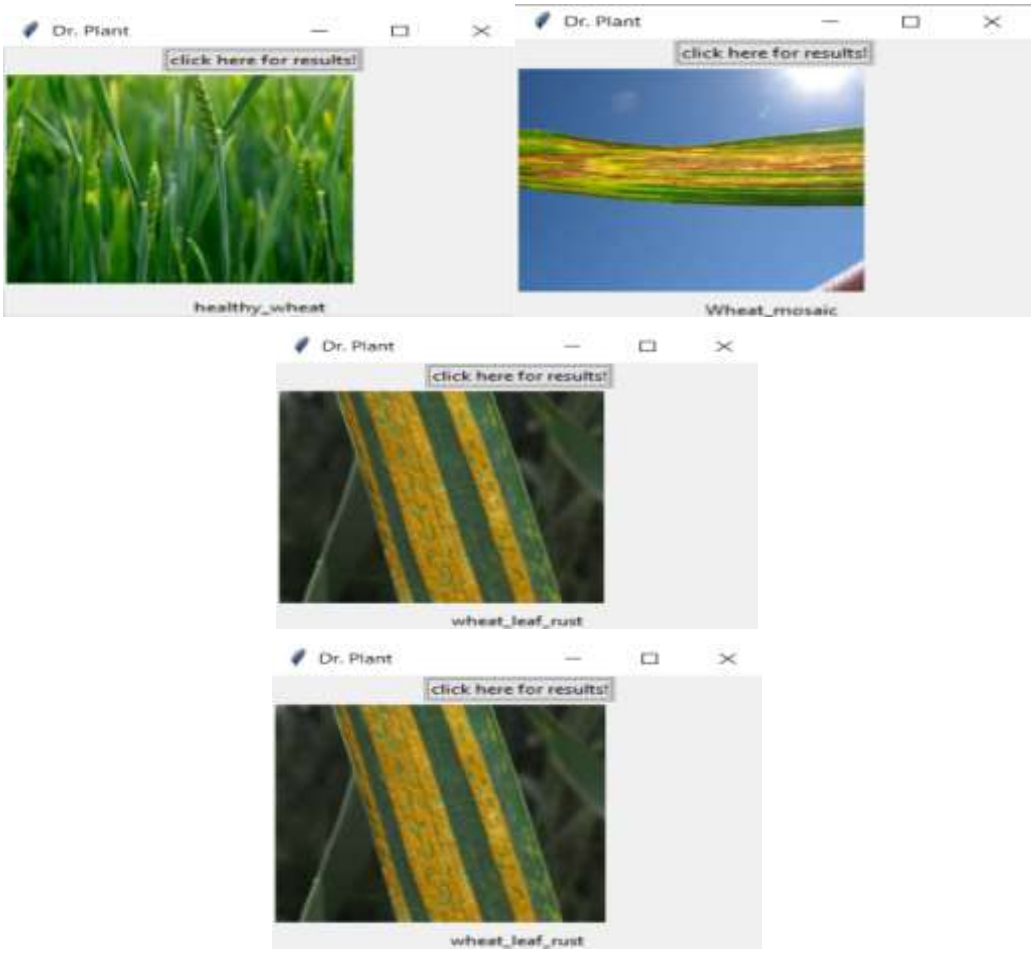

Fig. 8. Disease detection outputs

Future Enhancement

The proposed method could be developed into a real-time system based on video input, allowing for unattended plant care. For the training and testing of models, we can identify more types of wheat plant diseases and pests by combining new algorithms and other deep learning structures.We only highlighted a few diseases that are very common in wheat in this project, but it could be expanded to include more diseases in the future. This model can also be used on other plant species. An application might be created to make it easier to use and to provide better help to farmers and other individuals who are unfamiliar with technology.

4. Conclusion

The suggested method detects diseases that harm Wheat plants, allowing farmers to save crops at an earlier stage. It detects wheat plant illnesses using image processing and CNN. Our model has a 93 percent accuracy rate. Diseases in the leaves of other plants can also be detected using CNN. Farmers first send a digital photograph of a plant leaf, which is read and processed automatically using Image Processing and categorised using CNN. The goal of this project is to obtain meaningful data that can be utilised to identify diseased plants infected with common plant diseases and to provide a treatment for the diseased plant. To summarise, the Proposed System is effective, although it can yet be improved.

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