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Use of Multilayer Perceptron Algorithm for Detecting Crop Disease

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Crop Disease, Multi Layer Perceptron (MLP), Agriculture, Early detection, Accuracy, Precision and Recall.

ABSTRACT

In agriculture, one of the most challenging tasks is the early detection of crop diseases. It is essential to identify diseases early in order to boost agricultural productivity. To maintain the economical figure the crop damaging factors that affects yield as various diseases needs to be diagnosed and cured appropriately. However, manual disease identification is both time-consuming and error prone, and requires a thorough knowledge of plant pathogens. Instead, automated methods save both time and effort. This paper presents, use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease. The dataset here has been collected based on the pre-historic cultivation data and disease-affected data of the crop and live images from the field have been collected and the dataset has been created. The proposed application uses the Multi Layer Perceptron (MLP) Algorithm at its heart to distinguish healthy and infected leaves. The proposed works basically finds a solution of the crop disease detection using simplest method while keeping minimum computational complexity. Accuracy, Precision and Recall are the parameters used to evaluate the performance of described model. When compared to traditional models, the suggested MLP architecture exhibits in terms of highest classification accuracy, highest precision, high recall.

I. INTRODUCTION

Agriculture is the mainstay of many countries. Due to population growth, the demand for food is steadily increasing. To satisfy this pressing need, it is necessary to increase agricultural productivity and protect crops. Nevertheless, crops are highly prone to different diseases due to a large number of pathogens present in their environment. Leaves being the most sensitive part of plants show disease symptoms at the earliest [1]. The crops need to be monitored against diseases from the very first stage of their life-cycle to the time they are ready to be harvested. Crop diseases can reduce productivity by 10% to 95%, resulting in a significant decrease in the quantity and quality of agricultural

production. Therefore, early identification of diseases is crucial to avoid huge losses and reduce the excessive use of pesticides, which can harm human health and the environment.

So many years before, diseases are observed only by the naked eye having the examples of pretentious plants or the persons with the disease prediction skill observe the farm, and conservative measurements were taken by the farmers depending on their suggestions [2]. Skilled person's identification is a challenging task and their suggestions will not often cure the diseases. A huge period is required and costs are very high due to the need for experts. Any Country's root is agriculture so that the identification of disease in the agricultural product is more important [3]. Thus, few accurate, fast, automatic, and low-cost approaches are used for detecting diseases. The latest advancement of technology in the image processing and Machine Learning (ML) field will provide the economical knowledge of pesticides in farmers. Different methods can be applied for learning the task such as supervised learning, unsupervised learning and Reinforcement learning. In the supervised learning method training of model is done using labelled data. In supervised, no supervision is needed for training. Supervised learning means collect data and produced output depending on past experience [4].

In the products of agriculture, diseases are caused by mainly two factors: non-living and living agents. Living agents are viruses, fungi, bacteria, and insects. Non-living agents are temperature changes, increased moisture, light insufficiency, and decreased nutrients, and air pollution [5]. Identification of leaf, detecting leaf diseases and diseases in fruits, etc. are the diseases for which some agricultural applications are established. The digital camera captures digital images which are required by these applications. The information needed for the examination of diseases is extracted by the images captured which are applied with image processing and machine learning techniques.

This paper presents Use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease. The live dataset has been gathered and the pre-historic dataset has been collected from the cultivation land. Totally 1000 Leaf images are present in this dataset and which includes both crop disease leaves and Healthy leaves. Accuracy, Precision and Recall are the parameters used to evaluate the performance of described model. This paper organization is followed as Section 2 exhibits related works on crops. Section 3 describes the proposed design. The experimental results are depicted in Section 4. The conclusion is presented in Section 5.

II. LITERATURE SURVEY

In [6] presents Plant Disease Detection and Diagnosis model. To achieve the maximum level of precision, leaf colour, leaf damage, leaf area, and leaf texture are all classified qualities. CNN algorithm is used to examine various image parameters or features for the purpose of recognising various plant leaf diseases. In [7] provides a solution for plant disease detection using YOLOv5 and contributes to the development of automated agricultural management systems. We presented a computer vision approach applying the state-of-the-art YOLO algorithm with our own dataset consisting of 8 different classes of pant leaf diseases caused by fungi, bacteria, viruses and pest. Our system achieved promising results and effectively predicted the diseases with the bounding boxes and class probabilities.

In [8] applied a transfer learning technique for plant disease prediction. We used a 'plant village' dataset with augmentation collected from Kaggle. This abstract presents a comprehensive plant leaf disease detection approach using transfer learning. The proposed approach was evaluated using various metrics, including accuracy, precision, recall, and F1 score. The results demonstrated that transfer learning significantly enhanced the models' ability to differentiate between healthy and diseased leaves, with high accuracy and reduced false positives.

In [9] provides an evaluative study on the existing disease detection systems in plants. With the aid of imaging technology the plant disease detection systems automatically detect the symptoms that appear on the leaves and stem of a plant and helps in cultivating healthy plants in a farm. These systems monitor the plant such as leaves and stem and any variation observed from its characteristic features, variation will be automatically identified and also will be informed to the user. In [10] proposes a deep learning model based on modified Mask R-CNN for autonomous detection and segmentation of leaf diseases in plants. The model achieved a 0.98 accuracy and reduced lesion detection time by two times compared to existing models. The

proposed method shows promise in detecting leaf diseases in plants, which is crucial for promoting healthy plant growth and ensuring ample food supply.

In [11] propose a new descriptor that is based on local Directional Patterns to perform feature generation from plant leaves. This descriptor is associated with SVM classifier to develop the full detection system. Experiments are conducted by considering three crop species that are Tomato, Potato, and Bell pepper diseases. The proposed LDP features are evaluated comparatively to convolutional neural networks features as well as to the histogram of oriented gradients. The results obtained highlight the effectiveness of the proposed system which outperforms the LeNet-5 convolutional neural network by 3% in the over-all accuracy.

III. Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease

The block diagram of use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease is shown in below Figure 1.

The dataset here has been collected based on the pre-historic cultivation data and disease-affected data of the crop and live images from the field have been collected and the dataset has been created. Images are crop disease benchmark dataset of tomato and brinjal leaves is used to perform experiments. The live dataset has been gathered and the pre-historic dataset has been collected from the cultivation land. Totally 1000 Leaf images are present in this dataset and which includes both crop disease leaves and Healthy leaves.

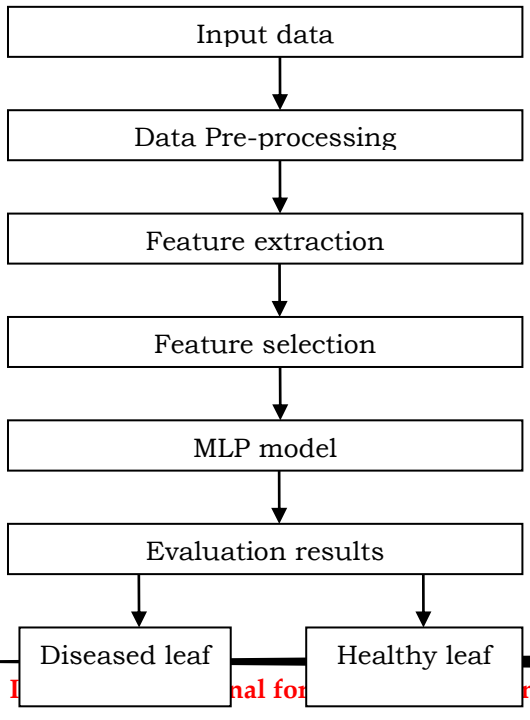

Figure 1. Block diagram of use of MLP for Detecting Crop Disease

The process of pre-processing technique transforms raw input leaf image datasets into desirable process datasets format to develop the quality of leaf images and to eliminate the undesired portions from the leaf images. These processes occur in various phases such as data cleaning, integration, reduction and transformation. These leaf image datasets are resized and converted into 256×256 dimension for training datasets and testing datasets analysis. So, pre-processing technique can provide preparing datasets to identify leaf diseases through the leaf image datasets.

Feature extraction describes an oversized set of information accurately. The leaf options like morphology, texture, and color that are needed to classify diseases are extracted. Gray level matrix formula is employed for research texture options. These options are calculated from an organization of information points associated with others at the given position. Then required features are selected from the list of extracted feature set.

A Multilayer Perceptron (MLP) is a type of feed-forward artificial neural network consisting of at least three layers: an input layer, hidden layers, and an output layer. In this approach, images of crop leaves or related agricultural data are first processed to obtain numerical features such as color, texture, and shape. These features are then fed into the MLP. The network learns patterns associated with healthy and diseased crops during training by adjusting weights using Backpropagation. Once trained, the MLP can accurately predict whether a crop is healthy or affected by a specific disease

Through the use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease effectively detects the crop disease using plant leaf analysis. Finally performance of model is evaluated using performance parameters as accuracy, precision and recall.

IV. Result Analysis

The performance of described model of use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease is evaluated in this section. Images are crop disease benchmark dataset of tomato and brinjal leaves is used to perform experiments. From the dataset, 80% of photos are taken for training and 20% for testing. We used accuracy, precision and recall parameters as evaluation metrics.

Accuracy: It refers to the proportion of correct guesses to total predictions. Accuracy can be described as the ability to accurately detect the outcome of a situation.

$$Accuracy = \frac{TP + TN}{TP + TN + FN + FP} \quad 1)$$

Precision: The ratio of positive no., of samples to the total no., of samples is known as precision.

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

Recall: The ratio of true positive no., of patterns to the total positive declared no., of patterns is known as recall.

$$Recall = \frac{TP}{TP + FN} \quad (3)$$

Here TP represents True Positive, the model predicted the instance as disease affected leaf and the leaf was disease affected; TN represents True Negative-the model classified that the leaf is not affected and the leaf is healthy; FN represents False Negative-the model predicted the instance as a healthy leaf but actually it was affected; and FP represents False Negative-the model classified it as disease affected leaf but it was a healthy instance respectively.

The performance of use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease is represented in Table along with comparative analysis of K-Nearest Neighbor (KNN) and Naïve Bayes (NB) based crop detection models with respect to performance parameters as accuracy, precision and recall.

Table 1: Comparative Performance Analysis

Detection models	Accuracy	Precision	Recall
MLP	95	96	96
KNN	89	90	89
NB	88	87	86

Graphical representation of Accuracy of use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease, K-Nearest Neighbor (KNN) and Naïve Bayes (NB) based crop detection model is represented in below Figure 2, in which described model achieves high accuracy value.

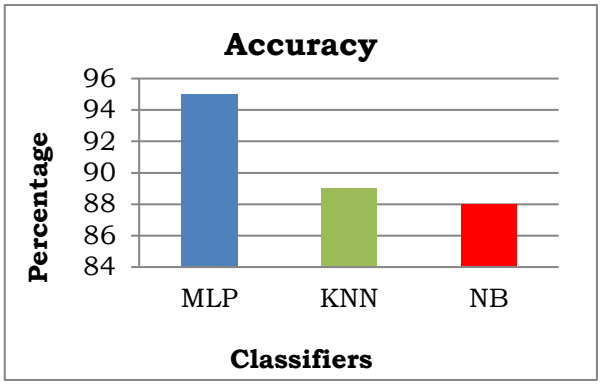

Figure 2. Accuracy analysis

Precision parameter comparative graphical analysis is represented in Figure 3 for use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease, KNN and NB based crop detection model. Figure 3 clears that highest precision percentage is obtained for described model.

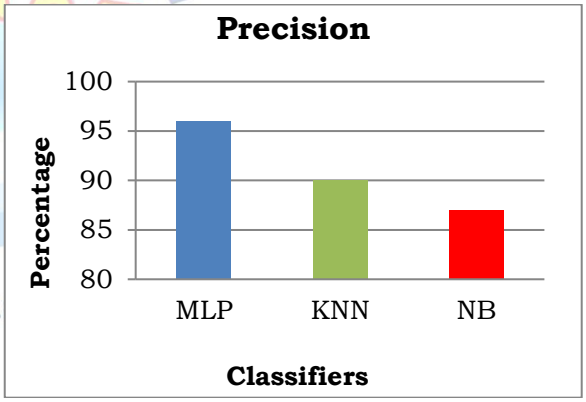

Figure 3. Precision analysis

Figure 4 shows the graphical analysis recall value of described model use of MultiLayer Perceptron (MLP) Algorithm for Detecting Crop Disease, KNN and NB based crop detection models. Described MLP model gains high recall value.

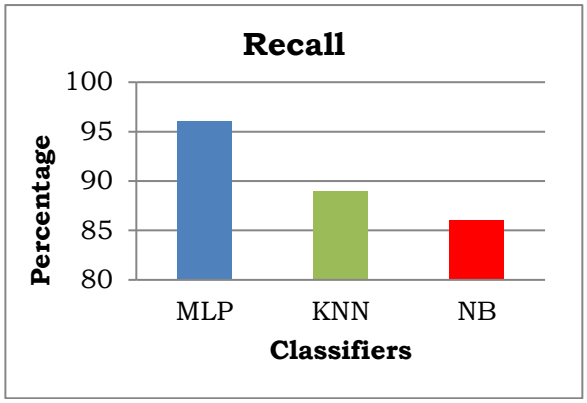

Figure 4. Recall analysis

Therefore from results it is clear that, use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease in terms of Accuracy, Precision and Recall. MLP model achieves 95% of Accuracy, 96% of Precision and 96% of Recall.

V. CONCLUSION

In this paper, use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease is described. Crop diseases are one of the main challenges in the farming sector. Thus, there is a need to identify crop diseases at the earliest stage to lessen disease severity. The proposed application uses the Multi Layer Perceptron (MLP) Algorithm at its heart to distinguish healthy and infected leaves. Images are crop disease benchmark dataset of tomato and brinjal leaves is used to perform experiments. Accuracy, Precision and Recall are the parameters used to evaluate the performance of described model. Therefore from results it is clear that, use of Multi Layer Perceptron (MLP) Algorithm for Detecting Crop Disease in terms of Accuracy, Precision and Recall. MLP model achieves 95% of Accuracy, 96% of Precision and 96% of Recall.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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