Leaf Disease Detection and Automatic Pesticide Suggestion using Deep Learning

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Abstract – Diseases that are caused by fungus are developed through soil-borne, above-ground infections. Pest and insect feeding causes the transmission of fungus. However, the existing research lacks an accurate and fast detector of leaf diseases for ensuring the healthy development of the agricultural industry. This project proposes a novel approach for developing an effective method for identifying the plant leaf diseases. Based on the identification of diseases, suggestion for the pesticide is also given. A deep learning approach which is based on Multilayer Deep convolutional neural networks (CNNs) for the real-time detection of leaf diseases is used in the work. It also detects the types of leaf diseases with high accuracy. In addition, the proposed approach can handle the images of the diseased leaves. The results showed good improvement in identifying the plant leaf diseases.

Keywords – Deep Learning, Leaf Disease, Convolutional Neural Networks, Leaf Disease, Food Productions.

I. INTRODUCTION

Food production in India driven by pressure from an increasing human population uses 90000t per year of technical-grade pesticide. It is very important to detect the plant disease and to increase the food production. Plant diseases may be due to bacteria, nematodes, fungi, phythoplasmal and viruses1–4. Diagnosing the symptoms of plant diseases is very crucial. Since limited number of plant pathologists is available, it is very difficult to identify the diseases in many regions in India. The plantation area of plants is so large to provide a solution. It also leads to difficulty in obtaining disease evidence.

It is important to remember that plants that are healthy and properly cared for will often show more resistance to plant disease, so ensuring your crop has ample moisture and healthy, fertile soil is a must. Recently, a deep study on plant diseases and their biological characteristics is going on. Since there are many plant diseases, it is challenging to identify the diseases and it is required to put a special attention on plant diseases. If the diseases are identified earlier, the quality of the products can be maintained. Traditionally, disease inspection, disease identification, and dealing with these diseases in plants are done manually.

The recent growth in the study of deep learning helps to detect plant diseases. In the proposed work, an efficient convolutional neural network (CNN)-based plant disease detection method is experimented which identifies the diseases in plants. CNNs are able to learn representative features of disease classes.

Deep learning is a type of machine learning and Artificial Intelligence. It consists of three or more layers. The layers simulate the human brain behavior.

In deep learning, a CNN/ConvNet is a class of deep neural networks, most commonly applied to analyze visual imagery in which a technique called Convolution is used. The mathematical operation on two functions that produces a third function is known as convolution.

The proposed system, a new web based work, analyzes the leaves of the plant and predicts the affected disease. It also provides the solution by suggesting the appropriate pesticide to be given to the plants. The work presents an automated system integrated with machine vision techniques that assists the farmers to get the accurate information about their Plants Leaf Disease. It also reduces the time consumed by the farmers.

II. RELATED WORK

It is crucial to improve the quality and quantity of agricultural products. The basic need of the people is satisfied. Growth of agriculture also supports the economic growth of any country. Smart farming is recently used to support the growth of agricultural products. If the plants are disease free, agricultural products can be produced with good quality and quantity. The recent works on computer vision broadly use deep learning to identify the diseases in the plant. Aniruddha Parvat [1] et al has developed the innovative solution that provides efficient disease detection in tomato plants. An image capturing box, motor-controlled captured the four sides of tomato plants. It was analyzed and identified the leaf diseases. A specific breed of tomato namely Diamante Max was used as the test subject

Research by Chanda. M and BiswasM M [2] focuses on building a model based on squeeze net architecture to classify seven types of tomato plant diseases on the leaves including healthy leaves. Keras deep learning framework was used to build the model. The data used in this study is the image of tomato plant leaves obtained from the Vegetable Crops Research Institute in Lembang, West Java. The work detected the disease in tomato plants successfully with an average accuracy of 86.92%.

Study of Fatih Ertam and Galip Ay [3] examined diseases which cause physical changes in the tomato plant leaves. RGB cameras found the changes in the leaves. Standard feature extraction methods detected diseases in plant leaves previously. However, deep learning approaches were used to detect diseases in this study. Two different deep learning network architectures AlexNet and then SqueezeNet were tested. The Nvidia Jetson TX1was used to train and validate the data for both of these architectures. Tomato leaf images from the Plant Village dataset were trained and tested. Ten different classes were used. Healthy images were also included. After training, the images were tested. The study showed good results.

Jing Sun [4] et al proposed research methods; in which cropping of pictures was done and the type of crops diseases were identified. The injured area of crop pictures helped to find the extent of the damage. The improved Hough transform algorithm identified the crop line. A robot was used for this study. The change on the spraying pressure and flow regulation was found out which was used to find the walking speed of robot spray rod that was adjusted by the middle controller. The experimental results showed that the robot system works stably and had favorable stability and practicability.

Kamilaris.A and Prenafeta-Boldú.F.X [5] performed a survey of 40 research works which had used that employ deep learning approaches for various agricultural and food production challenges. The work focused on agricultural problems for which the specific models and frameworks were employed. Deep learning approached were compared with other existing popular techniques. It was concluded that deep learning provided high accuracy, outperforming existing commonly used image processing techniques.

Lili li, Shuhuan Zhang and Bin Wang [7] classified the images of soya bean leaves as healthy and diseased using Support Vector Machine (SVM). Image acquisition, extracting the leaf from complex background, statistical analysis and classification were the important steps in the algorithm. Conversion of RGB to HSV (Hue Saturation Value) color space conversion was done during pre-processing step. Multi-thresholding was used for extracting the region of interest from the original image. The cluster-based methods were used for segmentation. Scale Invariant Feature Transform (SIFT) technique identified the leaf shape and automatically recognized the plant species. The SVM classifier showed good accuracy in automatic classification of images. The study showed that this approach the leaves were classified with an average accuracy of 93.79%. The work enabled the farmers to get advice from the agricultural experts with minimal efforts.

Y. Shih and S. Cheng [6] used Euclidean distance metric to find out the color difference between adjacent regions. The paper proposed a novel two dimensional look up table for labeling the neighbors for region merging. The image was traversed vertically and horizontally. If any change was noted in the labels of pixel, it was recorded in the look up table. The algorithm was first implemented in the YCbCr color space. Later, other color spaces like YCgCr, CIELAB and RGB were used to check the best performance of the segmentation algorithm.

Study of Liu.X [8] et al detected and classified plant leaf diseases automatically using image segmentation technique. A survey on different diseases classification techniques was also done for performing plant leaf disease detection.

III. PROPOSED METHODOLOGY

First the diseased leaf dataset is collected and then it undergoes the training process.

Preprocessing is performed to train the images. After preprocessing, segmentation which is used to identify the diseased spot of the leaf is performed. The next step is feature extraction that extracts the outline of the previous process. Then the disease is classified and stored in database.

Now the data is uploaded for testing then it undergoes preprocessing. After preprocessing, the next step is segmentation where the diseased spot of the leaf is identified. The next step is feature extraction it extracts the outline from the previous process. Classification of diseases is done. Based on the classified disease appropriate pesticide is suggested.

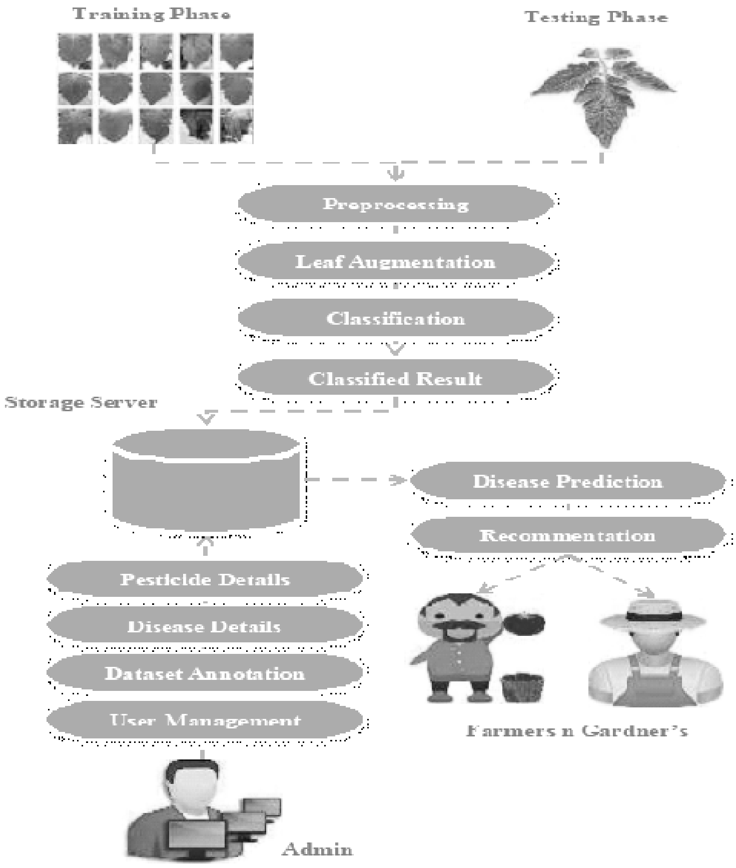

Fig 1. Proposed Methodology

The training and testing phases are depicted in Fig 1.

IV. EXPERIMENTAL ANALYSIS AND RESULTS

User name and password are to be entered in the login page.It also checks whether the User Name and Password is correct or not. If the User Name and Password is incorrect, the message "incorrect" is displayed.

After user completes Login, the user is to upload the files for training phase. It is required to have the data in the local device. If the file size exceeds 500 MB the file will not be uploaded in Fig 2.

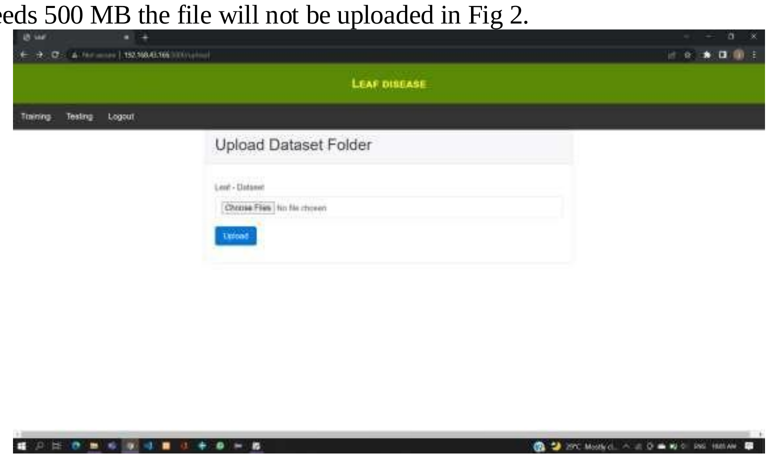

Fig 2. Upload Dataset

Training – Preprocessing

After uploading the data, the training process begins. The first step is Preprocessing where image is converted into binary file. It is depicted in Fig 3.

Fig 3. Training – Preprocessing

Fig 4. Training – Gray Scale

The second step in training phase is Gray Scale. Here the color image is converted to a range of shades of gray without apparent color. Fig 4 shows the converted image. The third step in training phase is segmentation, which represents the affected region of the leaf. Fig 5 shows the result of segmentation.

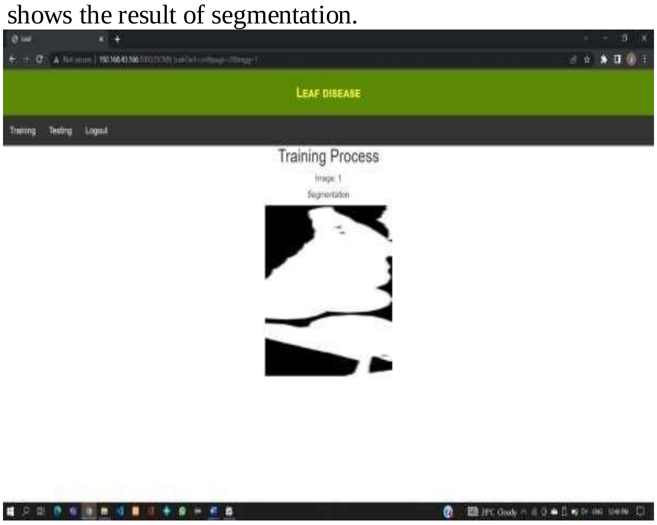

Fig 5. Training – Segmentation Training – Feature

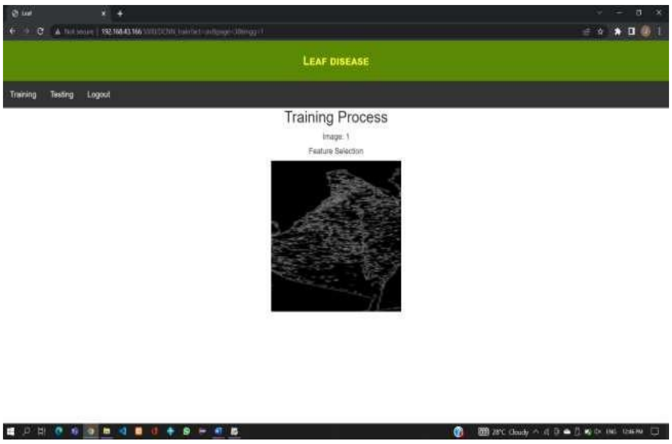

Fig 6. Training – Feature Selection Training

The fourth step in training phase is Feature Selection where diseased spots areisolated as shown in Fig 6.

Fig 7. Training – Classification Training

The fifth step in training phase is Classification, which classifies disease based onthe pattern present in the leaf. It is shown in Fig 7

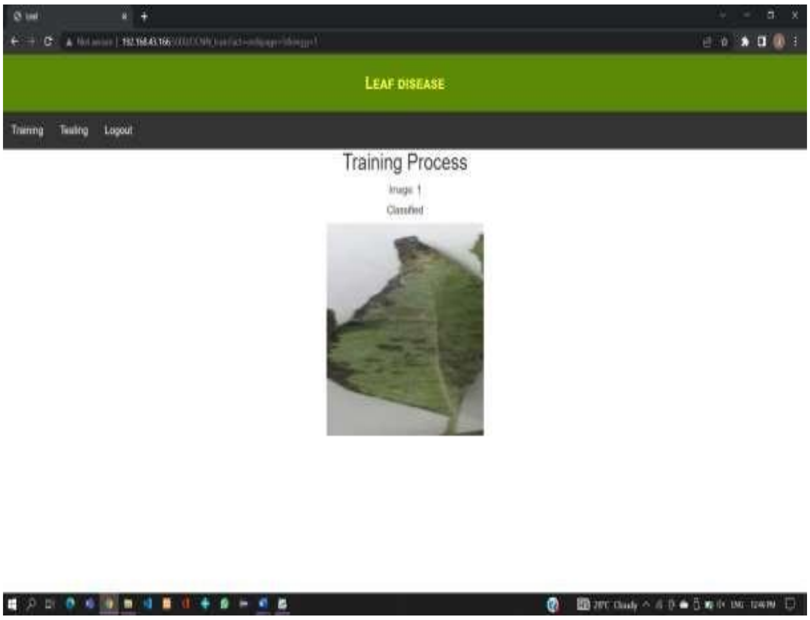

Fig 8. Training - ClassifiedTraining-

In Fig 8, the classified disease is shown. and the result is stored in a database. After completion of the training phase, "Training Process Completed" pop-upmessage is displayed as shown in Fig 9.

Fig 9. Training- Completed

After completion of the training phase, the input data for testing is to be uploaded. Since the size of r1.jpg is 20kb it is accepted by the system. After uploading the data, the testing process begins. The first step is Preprocessingwhere image is converted into binary file. The second step in training phase is Gray Scale. Here the color image is convertedto a range of shades of gray without apparent color. Fig 10 shows the converted image.

Fig 10. Testing – Gray ScaleTesting

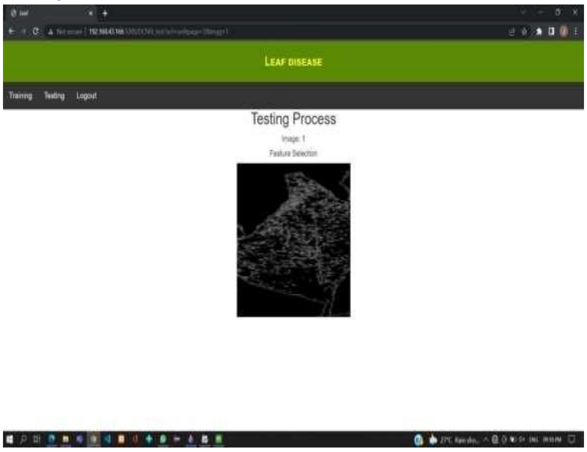

Fig 11. Testing – Feature Selection

The third step in training phase is segmentation, which represents the affectedregion of the leaf. Fig 10 shows the result of segmentation. The fourth step in training phase is Feature Selection where diseased spots areisolated as shown in Fig 11.

Fig 12. Testing – Classification

In Fig 12, the classified disease is shown. and the result is stored in a database.

In Test Result, the Suggestion will be provided based on the percentage level of attack of that disease. For the tested data, the disease percentage level is 13% subsequently disease is mild which is depicted in Fig 13. The symptoms areidentified as Damping off and purple blotch.

Fig 14 shows the appropriate pesticide for the identified disease. For supporting the farmers, the table showing the duration of cultivation is displayed.

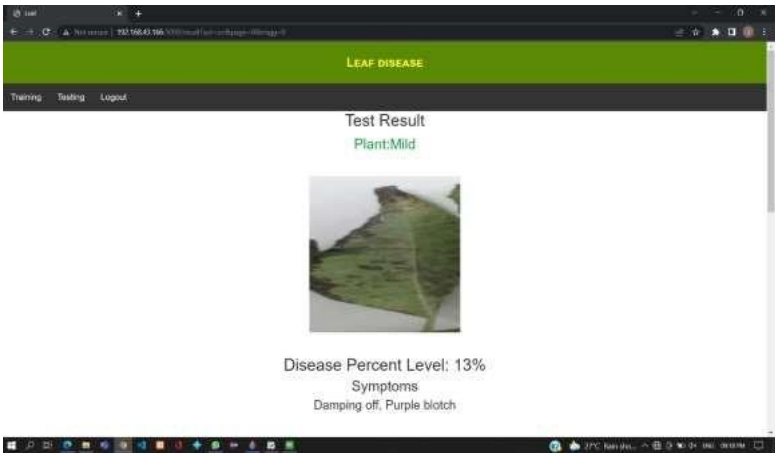

Fig 13. Test Result

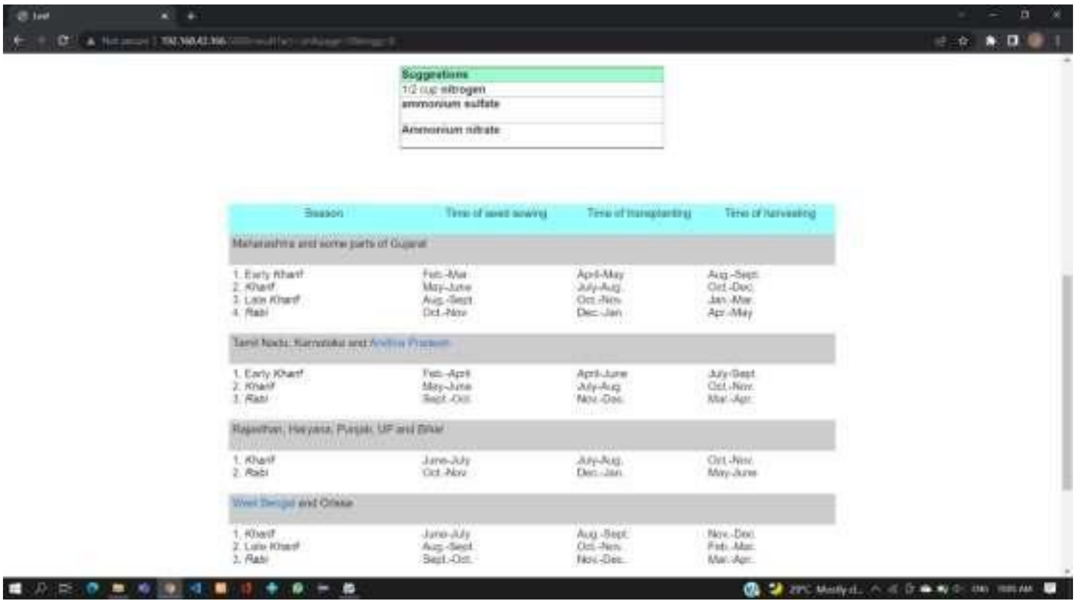

Fig 14. Pesticide Details

V. CONCLUSION

To overcome the issue in traditional approach of agriculture, the proposed work identifiesthe disease in the leaf and suggests appropriate pesticide for the leaf disease which leadsto increase in production.

With the development of artificial intelligence technology, the research focus of plant diseases detection and pesticides suggestion based on machine vision has shifted from classical image processing and machine learning methods to deep learning methods, which solved the difficult problems that could not be solved by traditional methods. To fully explore the potential of this technology, the joint efforts of experts from relevant disciplines are needed to effectively integrate the experience knowledge of agriculture and plant protection with deep learning algorithms and models. Also, the research resultsshould be integrated into agricultural machinery equipment to truly land thecorresponding theoretical results.

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