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INTELLIGENT FRAMEWORK FOR DETECTION OF PLANT/CROP DISEASES USING DEEP LEARNING

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Abstract: The financial influence of agriculture today is expanding in tandem with the economy of our nation and has become the large industry which plays a vital and crucial role for the uplifting of our nation. Keeping track of plant diseases caused by the assistance of experts could be expensive when it comes to the agricultural area, so there is a need for a system capable of automatically identifying since it could revolutionize the monitoring of vast fields of crops and allow for the plant's treatment of leaves as soon as possible after disease detection. There are numerous illnesses that harm various plants/crops and hamper their growth and agricultural fields. So there is a need to identify the disease and tell how to recover from it. So there is a need to develop such an application which could help in the prediction of plant/crops disease and how to recover from the same. In many nations, including India, agriculture is a substantial industry. Given that a massive portion of the Indian financial system depends on agricultural production, it is crucial to give the issue of food production a careful study. The agricultural industry gave immense importance to the nomenclature and acknowledgment of crop infection on both technical and financial level. While monitoring the plant diseases which are caused in the agricultural fields with the help of experts could be very expensive in the long run so a technique or system that can recognize diseases automatically is required because it could change the way the vast fields of crops are monitored, and a perfect automated system could be built which could easily detect the plant diseases. It has become a necessity to develop an automated system which could easily detect the plant diseases beforehand and could easily help in overcoming them by suggesting the measures and techniques to overcome them. So that agricultural productivity could be increased, and agricultural production could be done properly with vast production of good quality crops which in turn help in growth of our nation.

Keywords: Deep Learning, Feature Extraction,Transfer Learning, Image Processing,Convolution Neural Networks

I. INTRODUCTION

Agriculture is the foundation of the Indian economy, according to Mahatma Gandhi, our nation's father, who said this six decades ago that in terms of global agricultural output, India comes on second position. Farmers grow enormous varieties of crops in India, which accounts for employment for about 42 percent of the Indian population. The growing expansion of agricultural fields is essential for both earning valuable foreign exchange and attaining self-sufficiency. Productivity of the crops is hampered by numerous factors such as climate, soil, numerous diseases which are some of the main factors for poor quality of agricultural crops production. One of the main factor in the increasing the overall crop production is the detection of diseases in plants and diagnosing them. Out of the mainly options available for identifying plant diseases is through visual inspection, which often includes extra human efforts,specialized laboratories and high costs.

Moreover, applying incorrect pesticides due to incorrect diseases' diagnosis may lead to reduction of the crops' ability to prevent itself due to infections to develop long term resistance. The various sections of the damaged crop can be easily observed to identify the plant disease. Using pesticides and other treatments, crops can be shielded against pests. Using NLP for processing of the image and DL algorithms for developing a unique approach to identify plant diseases and provide the remedy to cure plant diseases by creating web application equipped with necessary software to detect plant diseases and provide support for protection of the plant for enhancing the overall agricultural production and giving good quality crops which could lead to the uplifting of the economy.

Development of the model via web application is less expensive for small scale farming and cost-effective for industrial farming. The entire automated process has series of steps being carried out progressively and the output of each stage is taken as an output. The main objectives of the project are as follows: 1. To create a system that accurately detects crops disease and pests. 2. To establish the database of different diseases or illnesses occurring in the crops and pests. 3. To provide treatment for the recognized disease. The development of this type of system to recognize agricultural illnesses is the goal of this idea. In the web application build, the user needs to upload the image in the options available for upload in the system itself. The

uploaded image is predicted according to the disease found in that image and further diagnosis is provided for the disease and the final report for the disease is taken out so that sufficient action could be taken at an appropriate time which could help in increasing the agricultural production. Therefore, there is need for the novel technique development for careful diagnosis of the disease and prompt treatment of the disease is suggested.

II. LITERATURE REVIEW

An overview of the function of agriculture in the global economy is given in the 2014 article "Agriculture in the Global Economy" by Alston and Pardey, which appeared in the Journal of Economic Perspectives. The writers talk on how agricultural productivity has changed, how technological advancements have affected agriculture, and how agricultural research and development has shaped the world food system. They also look at how agricultural trade patterns are evolving and what this means for the future of food security worldwide. [1] Overall, the report emphasizes the value of agriculture as a significant sector of the global economy and the necessity for ongoing financial support for agricultural research and development to ensure the distribution and production of food that is sustainable into the future.[2]A overview of current developments in employing deep learning algorithms for plant disease detection and classification is presented in the publication "Plant Disease Detection and Classification by Deep Learning—A Review" by Li, Zhang, and Wang, which was published in IEEE Access in 2021. The authors talk on the difficulties in diagnosing plant diseases, including the wide range of symptoms and the requirement for prompt and precise detection. They then give an overview of the many deep learning techniques, such as convolutional neural networks, recurrent neural networks, and deep belief networks, that have been created for the detection and classification of plant diseases. The study emphasizes the possible uses of these approaches in precision agriculture and crop management, and also explores the various datasets that have been utilized for training and testing these models.

[3]. An innovative method for diagnosing fruit illnesses using photos is presented in the work "Adapted Approach for Fruit Disease Identification using Images" by Dubey and Jalal, which was included in the 2013 edition of the book "Image Processing: Concepts, Methodologies, Tools, and Applications" by IGI Global. The authors go through the difficulties in manually identifying these illnesses, as well as the significance of early fruit disease diagnosis for increasing crop production and quality. They suggest an automated method that entails taking pictures of the fruit and processing those pictures using image processing methods. The suggested approach's many phases, such as picture capture, image enhancement, feature extraction, and classification, are described in detail in the study. The authors further assess the effectiveness of the suggested method, utilizing a dataset of photos of various types of fruits with varying degrees of disease severity.

[4]. A dataset of images of citrus fruits and leaves is presented for the detection and classification of citrus diseases using machine learning techniques in the paper "A citrus fruits and leaves dataset for detection and classification of citrus diseases through machine learning" by Rauf et al., published in Data Brief in 2019. The authors talk about how early identification and precise diagnosis of citrus illnesses are crucial for increasing crop output and minimizing financial losses. Images of citrus fruits and leaves in good condition as well as those with five distinct forms of illnesses were gathered into a dataset.

[5]. A technique for detecting numerous plant illnesses using convolutional neural networks (CNNs) is presented in the paper "A Multi-plant Disease Diagnosis Method Using Convolutional Neural Network" by Mohsin Kabir, Quwsar Ohi, and Mridha, which was published on arXiv in 2020. For enhancing crop health and productivity, the authors stress the need of early identification and precise diagnosis of plant diseases. They suggest a technique for diagnosing several plant diseases that entails taking pictures of various plant species' leaves and using a CNN-based model to analyze them.

[6]. A novel approach for classifying rice plant diseases using a deep convolutional neural network (CNN) is presented in the paper "A novel approach for rice plant diseases classification with deep convolutional neural network" by Upadhyay and Kumar, published in the International Journal of Information Technology in 2022. The authors stress the need of early identification and precise diagnosis of illnesses affecting rice plants in order to increase crop output and minimize financial losses. They suggest a method that includes taking pictures of rice plant leaves and applying a deep CNN-based model to analyze them.

[7]. A method for identifying plant diseases using deep learning techniques is presented in the paper "Image-based Plant Diseases Detection using Deep Learning" by Panchal et al., published in Materials Today Proceedings in 2021. For enhancing crop health and productivity, the authors stress the need of early identification and precise diagnosis of plant diseases. They suggest a method that includes taking pictures of plant leaves and utilizing deep convolutional neural networks (CNNs) to analyze them. The suggested approach's many phases, such as image preprocessing, feature extraction, and classification, are described in the study. Using a collection of photos of leaves from several plant species with many disease classifications, the authors assess the efficacy of the suggested technique.

[8]. An overview of deep learning methods that have been utilized for plant disease detection and diagnosis is given in the paper "Deep learning models for plant disease detection and diagnosis" by Ferentinos, which was published in the journal Computers and Electronics in Agriculture in 2018. The author emphasizes how early and precise identification of plant diseases is crucial for increasing crop output and minimizing financial losses. The study examines several deep learning models that have been applied to the detection and classification of plant diseases, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs). The author presents examples of research that have successfully used these models for identifying and diagnosing plant diseases in a variety of crops, and explores the benefits and drawbacks of each technique.

[9]. A transfer learning strategy for plant disease diagnosis is suggested in the paper "Using deep transfer learning for image-based plant disease identification" by Chen et al., published in the journal Computers and Electronics in Agriculture in 2020. The authors stress the significance of precise and early plant disease identification for raising agricultural output and lowering financial losses. They

suggest a deep transfer learning strategy that entails optimizing a convolutional neural network (CNN) that has already been trained to recognize plant diseases. The authors compare their approach to other cutting-edge techniques and assess how well it performs on two separate datasets related to plant diseases.

[10]. A deep learning method for diagnosing plant illnesses based on convolutional neural networks (CNNs) is presented in the paper "Identification of plant diseases using convolutional neural networks" by Jadhav et al., published in the International Journal of Information Technology in 2021. The authors suggest a CNN-based model that is trained using a collection of plant picture datasets and disease labels that go along with them. The size of the dataset is increased by the authors using data augmentation techniques, and they assess the effectiveness of their method using a number of measures, such as accuracy, precision, recall, and F1-score. The authors demonstrate that their strategy yields superior accuracy rates when compared to other cutting-edge technologies. Additionally, they do studies to look at how various hyperparameters affect how well their method works.

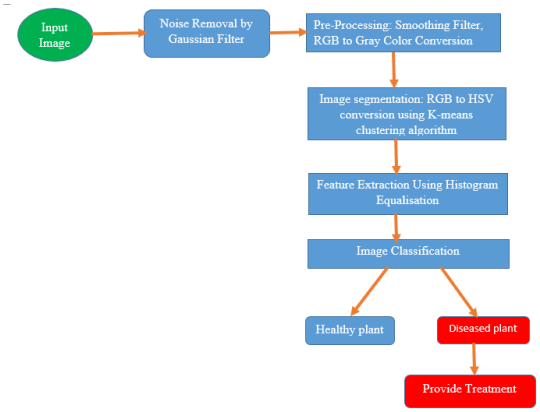

Fig 1. shows the Block Diagram

III. METHODOLOGY

The methodology adopted for the development of this web application revolves around necessary DL algorithms for model training and frontend and backend development of the web application so that an accurate detection and prediction app gets developed which is very essential for enhancing the overall food production and in turn leading to the overall development of the nation and upliftment of the Indian economy. The concept used in the approach is in ml and DL which are used in building the model, training, and predicting the disease. Ml used is basically a self-learning computer on the basis of the trained algorithm. For the development of the web application various frontend technologies are used which are more frequently used, and certain frameworks are also used which are overall helpful in building the web application. The block diagram of the above approach is as follows:

The overall step-by-step process of the development includes the following tech stacks and technologies and series of steps and procedures to reach the final result, and it happens in the following way:

Step1: Developing the UI for the web application

Fig 2. shows the UI of the web app

Step 2: Code for the Frontend of the web application.
Step 3: Developing the predictive model for prediction of certain disease using necessary ml and DL algorithms.
Step 4: Connecting it with necessary backend.
Step 5: Incorporating the entire functionality in the same web app.
Step 6: Finally completing the web app.

This app, which uses DL algorithms to predict the diseases in your crops. It implements various DL libraries to build robust and efficient neural network which can easily provide instant and accurate results.

The different stages of the project development involve acquiring and pre-processing the input test image before converting it to array form for comparison. The chosen database is correctly pre-processed, separated, and then renamed into the appropriate folders. The chosen appropriate algorithm properly trains the model after which organization happens. The display of the results takes precedence over the test image correlation with the trained model. If there is an illness or disease in the plant, the software displays the disease as well as the treatment.

The whole development of the project involves implementing the necessary concepts and technologies related to the model training and visualizing it via web application, which proves to be beneficial for increasing the overall good quality crop production and finding the necessary cure for the disease.

IV. RESULTS AND DISCUSSION

The final portal is developed, which in turn gives an overall overview of the crop's disease like predicting the disease and giving solution to the problem so that strict action could be taken, and sufficient care should be given to the crops so that good quality crops could be generated and overall the crop's health could be taken care of. Thereby increasing the productivity and quality of the cotton crops which gives the view to select a particular image from the given no of images and predict the disease in the given cop/plant and

derive the results as to which plant is diseased and which almost requires necessary support for disease detection and thus providing the necessary solution and cure for the disease so that necessary actions can be taken.

The view of the web application is shown below which is an application of ml,dl,nlp and development which is used in the development of web application and in turn leads to the development of the overall web application and its view is shown below- View of the web application:

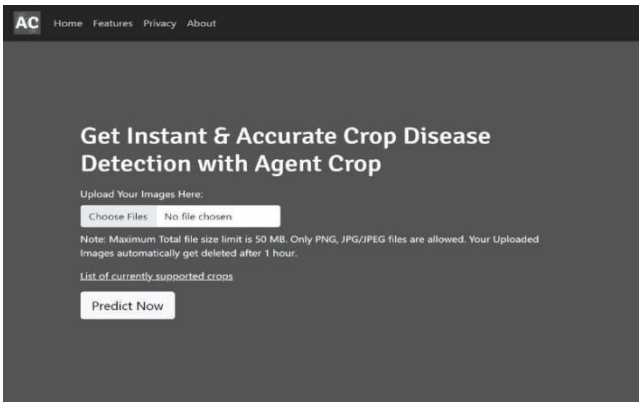

Fig 3. shows the Frontend of the Portal

After model training and deployment, the web app view is shown below:

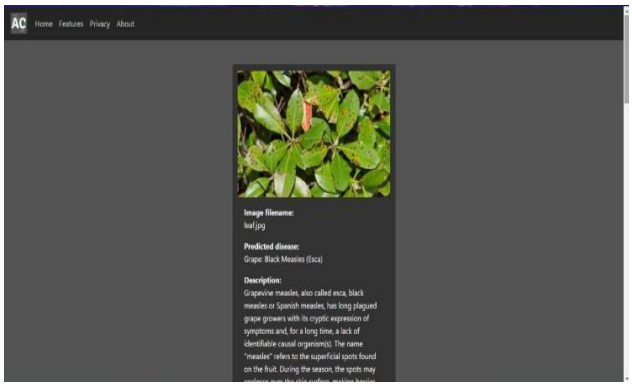

Fig 4. shows the Output of the web portal

Analysis of the results obtained as follows:

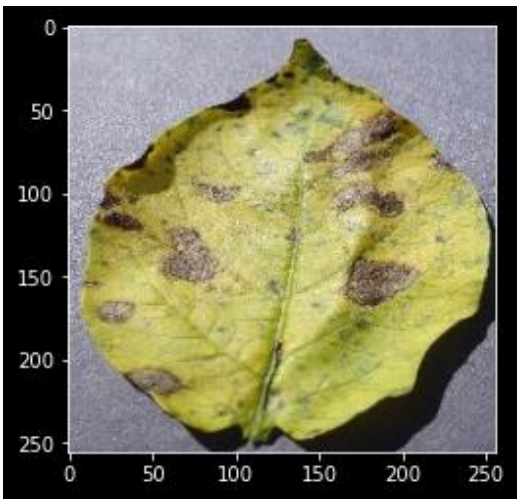

Fig 5. Prediction Results

After the entire app building process is completed after which the entire web app is tested against a variety of diseases and is then fully deployed which further leads to it being publicly available and also tried to convert into mobile friendly application to make it user-friendly and easily available to people so that it is easily accessible and available to everyone whoever needs it.

The graphs between Training Loss vs Validation Loss and Training Accuracy vs Validation Accuracy is as follows:

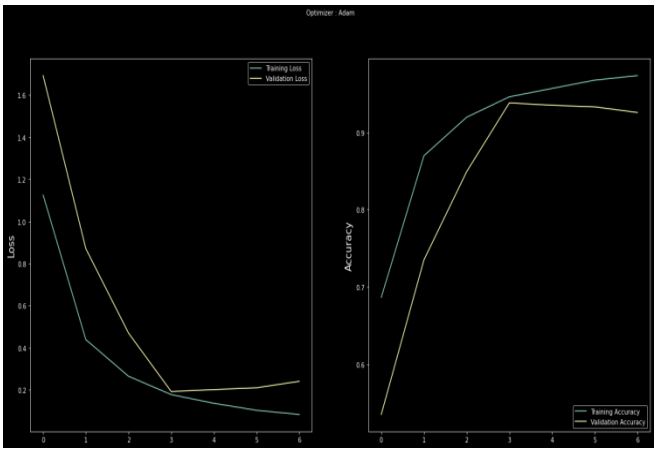

Fig-6: shows Training Loss vs Validation Loss and Training Accuracy vs Validation Accuracy

IV. CONCLUSION

After the whole web app development process gets completed, we will be able to get the final result of the whole process and be sure of the disease present in the plant/crop and take necessary action as soon as possible so that appropriate action could be taken regarding the quality of crops. It will serve as an effective tool and helpful for the detection and prevention of the diseases in the plants/crops. Although the models have been built and a good amount of research work has been done in this area, but it could prove to be very helpful when it comes to preserving the crop's safety. It directly impacts the country's economy in the long run and if good quality crops are developed then it becomes very essential to improve the overall productivity so that the growth of the nation is done. Hence, it is very important to use this tool in the agricultural sector in order to boost the crop's quality and hence the overall good productivity of the crops available.

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