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TOMATO PLANT DISEASE PREDICTION USING DEEP LEARNING

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Abstract: This study has been undertaken to the development of a deep learning-based system for predicting tomato leaf diseases, which are particularly significant in the agricultural industry due to the crop's high commercial value and contribution to food security. The proposed system utilizes a deep convolutional neural network (CNN) with transfer learning. The system determines plant health and predicts the specific disease if present.

Index Terms – Deep learning, Convolutional Neural Network (CNN), Transfer learning,Image Preprocessing, Tomato leaf disease, Early detection, Web application, Agricultural productivity.

1.INTRODUCTION

Plant disease identification is an important and useful task in agriculture since the early detection of diseases prevents the spread of the disease and finally the loss of the products [1]. Tomato, a nutrition-rich plant with a high source of income for farmers, is one of the most widely grown plants worldwide. However, various tomato plant diseases observed on leaves affect the products in terms of quantity and quality, and therefore, decrease productivity. Some well-known diseases of tomato leaves includeTarget spot, Yellow leaf curl virus, Healthy leaf, Leaf Mold, Spectoria leaf spot, Spider mites two spotted spi, Bacterial spot, Mosaic virus, Early Blight, Late Blight.

In this paper, a compact deep convolutional neural network (CNN) architecture is proposed to learn the relationship between a tomato leaf image and its corresponding disease, which is a classification task. One of the advantages of using convolutional neural networks is that they automatically extract relevant features throughout their convolutional layers, making them a powerful classifier for computer vision based tasks. The aim of this paper is to implement a robust deep network with high accuracy and at the same time with a computationally cheap architecture in terms of the number of parameters which are contained in the network in order to be used in the devices which have limited memory or processing capacity such as mobile phones and small quadcopter drones.

2. LITERATURE SURVEY

We all know that most of the Indian land is used for agriculture purpose, and it is also the main stay of India's economy. It is the major source of livelihood for about 58 percent of Indians. In India we know Tomato is one of the most important crops which plays a dominant role in the food industry and the agricultural economy of the country, but there are various diseases which obstruct the growth of crops in fields which may cause huge loss in the quality of products. Nowadays various methods such as image processing are used to diagnose various types of diseases caused by bacteria such as fungi, viruses and bacteria that cause significant loss of production. The main purpose of this project is to use deep learning concepts like CNN, Resnet, etc. system which will be used to detect various types of diseases of a Tomato

plant. It gives more capable ways to discover infections caused by Bacteria and environmental effects. Traditional methods include manual monitoring of a leaf and predicting the disease. But a farmer is not able to determine the exact disease by this technique. So, by using deep learning the proposed system will detect the diseases in a better way. Types of disease like Early Blight, Spectoria leaf spot, Late Blight, Bacterial spot, Leaf Mould, Spider mites two spotted spider mite, The Mosaic virus, Target spot, yellow leaf curl virus will be covered under this model.

Earlier a lot of work has been done in the digitalization of grading system using ML in agriculture industry, various approaches and algorithms have been implemented to get the required output. Many of them predicated the class correctly with good accuracy but the research to increase the accuracy of model is still going on, as the accuracy matters the most to decide which type of disease the plant is having as the further precaution could be taken to save the plants. Idea every year throughout India many crops yield get wasted due to diseases, no proper identification of disease and no timely cure makes huge loss in crops. To solve this issue, we propose a system which will predict the disease of crop based on its leaf image with help of CNN algorithm. Farmers use traditional method like manually examining of a leaf or plant to detect disease, but this technique does not help them to determine the exact disease which creates a huge loss of production. A web as well as web app-based system will be implemented which will be use to upload image of tomato leaf and get the predication of disease it is suffering from. If the leaf is having the disease, then a cure or precautionary method would be suggested to stop disease from further spreading. This study proposes a system focused on the detection and identification of diseases that are useful for decision making. The proposed system includes four main stages: pretreatment, segmentation, feature extraction and classification. In this method, we focus on image classification techniques that are different from image splitting.

3. RELATED WORK

Early detection of tomato plant diseases directly affects the quantity and quality of plant products.Through the integration of advanced image processing techniques and machine learning algorithms, the project aims to advance India's digital agriculture initiatives.CNN have become popular for plant disease identification over the last few years. This allows for the classification of large data with high accuracy. Many variants of CNN have been implemented by researchers for tomato plant disease diagnosis with the best detection accuracy of 99.53% [5]–[7], [13]. In this respect, [8] proposed a simplified and efficient CNN model with 8 hidden layers for tomato crop disease identification. The authors employed a lightweight CNN model to classify nine types of tomato crop diseases in the PlantVillage dataset.The high accuracy achieved by the model is of great significance in terms of agricultural productivity and disease management.The trained model achieved an impressive accuracy of 94.39% on the test set. This accuracy indicates the model's ability to correctly classify tomato leaf images and identify the presence of diseases.

SVM was not giving good results with more than 2 different types of disease, so in case of a greater number of accuracy and getting good accuracy the CNN algorithm is best to be implemented.Deployment of the model will be done through a website and android app which will take image as input and predict the type of disease.

The state-of-the-art methods related to tomato disease identification indicates that deep learning based approaches achieve high performance compared to hand-crafted methods, however it still needs more research in order to improve the accuracy to the highest level and reduce computation time.

4. IMPLEMENTATION

Basic stages of the Implementation:

A) CNN Model

1. Dataset,Data Preparation And Sources of Data
2. Image Collection And Image Pre-processing
3. Image Lablling
4. Training and Testing datasets
5. Model Building And Deployment
6. Implement Model
7. Expected Output

A) Praposed CNN Model

The proposed Deep Convolutional Neural Network (CNN) model was developed with transfer learning.The system determines plant health and predicts the specific disease if present. First model is made using the CNN algorithm as CNN is the most efficient image processing algorithm and provides the best model accuracy. To build a model 8 CNN filters are used in the layer selection 4 are convolution with relu activation function and every convolution is followed by max pooling. First convolution layer contains input shape (150, 150, 3), filter size 64, kernel size (3 x 3).

1. Dataset,Data Preparation And Sources of Data

The dataset consists of three parts: training, validation, and testing, each containing images of tomato leaves.There are total of 10 classes representing different types of tomato leaf diseases.(Target spot, Yellow leaf curl virus, Healthy leaf, Leaf Mold, Spectoria leaf spot, Spider mites two spotted spi, Bacterial spot, Mosaic virus, Early Blight, Late Blight). Each class corresponds to a specific disease, such as target spot, yellow leaf curl virus, early blight, late blight, and more.Total images in dataset were 22000 out of which 18000 were used for training and 4000 for validation purpose. 85% of the total images were used for training and 15% were used for testing.

The data set collection is the plant leaf disease image data collected from the information on the performance. Then, data cleaning and data reduction are done from the collected plant leaf dataset records. These data of the plant disease, plant leaf information for the leaf size, leaf color, quality and then plant characters are collected from the dataset performance.

The dataset used in this project was obtained from Kaggle, a popular platform for data science and machine learning.Kaggle provides a diverse collection of datasets contributed by the community, including agricultural datasets for plant disease detection.

Dataset contains of total of 31279 tomato leaf images, which are categorized in 10 different classes out of which 9 are diseased and 1 is healthy. The dataset used in this project was obtained from Kaggle, a popular platform for data science and machine learning. Kaggle provides a diverse collection of datasets contributed by the community, including agricultural datasets for plant disease detection.

2. Image Collection And Image Pre-processing

2.1 Image Collection :- The dataset was downloaded from Kaggle which consisted of 3 parts train,validation, and test with 10 classes each.

2.2 Image Pre-processing :- The images initially consisted of nonuniform size so to create uniformity in the image size we converted all the images in fixed size. Deep learning projects need a large amount of data to acquire good accuracy for the model hence, image augmentation is good technique to obtained large data from existing data by performing various operations on the image like rotation, flip, width shift, height shift,

fill, etc. This creates more images from the existing images which help in increasing the accuracy of the model.

3. Image Lablling

There are ten Labels including

- Target spot
- Yellow leaf curl virus
- Healthy leaf
- Leaf Mold
- Spectoria leaf spot
- Spider mites two spotted spi
- Bacterial spot
- Mosaic virus
- Early Blight
- Late Blight

4. Training and Testing datasets

Total images in dataset were 31279 out of which 24847 were used for training and 6432 for validation purpose. 80% of the total images were used for training and 20% were used for testing.

5 .Model Building And Deployment

First model is made using the CNN algorithm as CNN is the most efficient image processing algorithm and provides the best model accuracy. To build a model 8 CNN filters are used in the layer selection 4 are convolution with relu activation function and every convolution is followed by max pooling.

Deployment of the model will be done through a website and android app which will take image as input and predict the type of disease.

6. Implement Model

7. Expected Output

The system should be able to predict all types of disease's correctly, and a suitable solution should be provided, all of this should be done in few seconds and the system should be user friendly.

7.1)

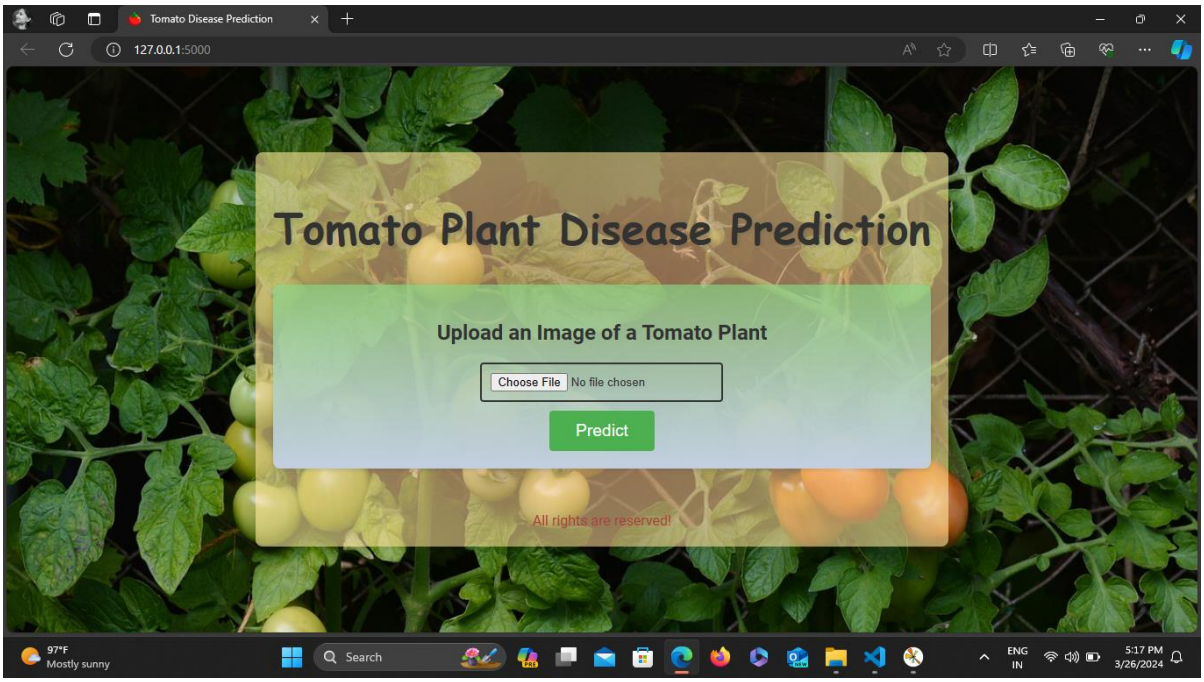

Figure: Home Page

7.2)

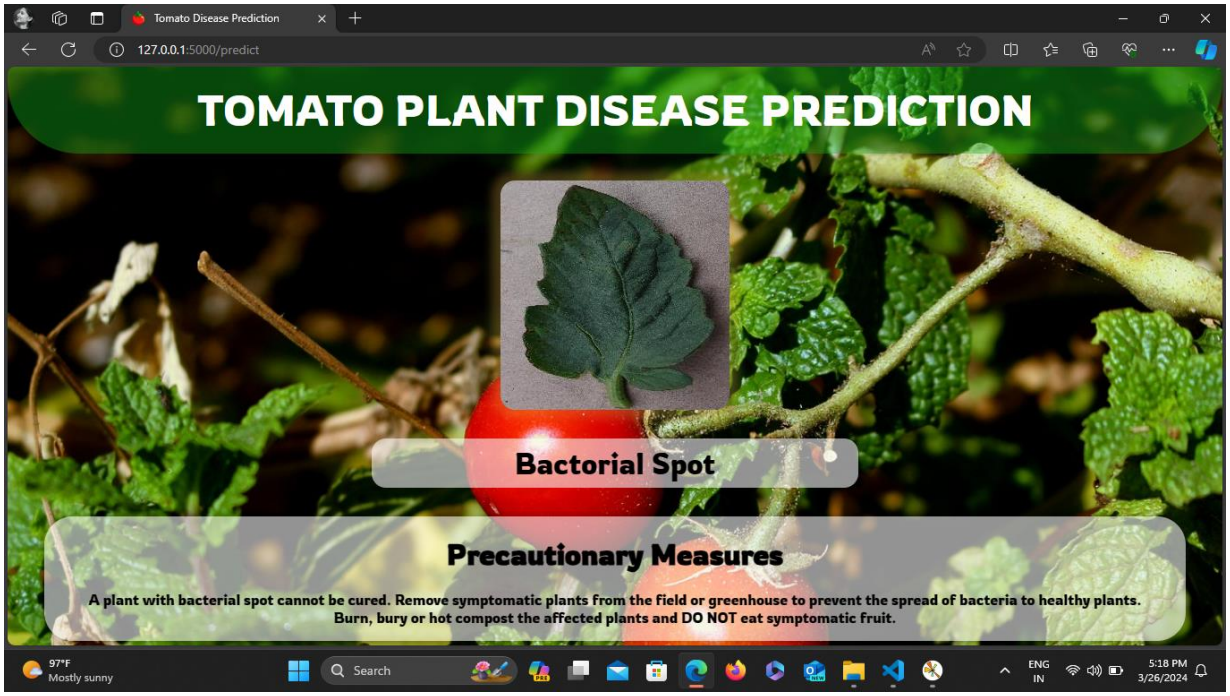

Figure: Prediction(Output)

B) Algorithm Flow

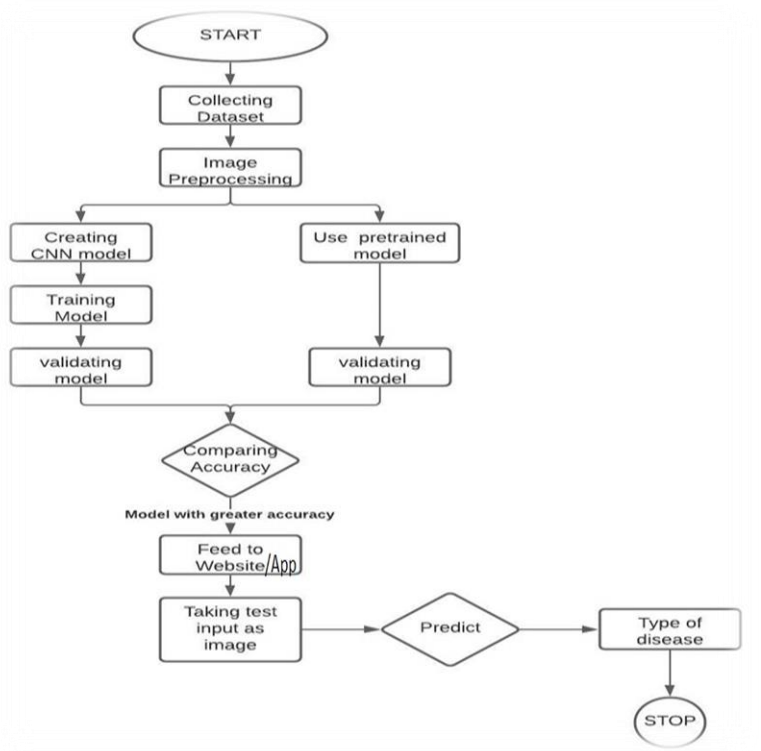

Figure: Flow of Algorithm

5. RESULTS AND DISCUSSION

5.1 Results

- Disease should be predicted correctly
- Farmer should be able to use interface easily
- Farmer should be able to prevent disease spreading by taking proper measures
- Loss of crop yield should be reduced.

5.2 Discussions

As from literature survey we understood that after doing a comparative study on same datasets with different type of algorithms the CNN was the algorithm which was giving the best results among other also in that Dense net was a pretrained model which was giving overall good results. SVM was not giving good results with more than 2 different types of disease, so in case of a greater number of accuracy and getting good accuracy the CNN algorithm was best to be implemented".

6. CONCLUSION

On implementing Deep learning models, Convolutional Neural Networks (CNN) on the disease detection of tomato leaves from the plant village dataset and evaluating the aforementioned model using the following metrics: Accuracy, Precision, and Recall, the study shows that CNN model performs better than other Machine Learning model in the plant disease detection of tomato leaves by outperforming the KNN model is all of the four-evaluation metrics. The study also makes use of the XAI technique Local Interpretable Model-agnostic Explanations (LIME) in order to provide explain ability to the predictions made by the models. With the execution of a user study, this study can get feedback from farmers on if they trust the AI and XAI models. A Web-based systemhas been successfully implemented for tomato leaf disease

prediction using Convolution Neural Network. There are 10 classes that are detected by system with accuracy of 94.39%. This was achieved using approximate 31279 images from which 24847 were training images and 6432 were testing images.

REFERENCES

I. Emre Özb˙ilge 1 , Mehtap Köse Ulukök 2 , Önsen Toygar 3 , And Ebru Ozb˙ilge 4, "Tomato Disease Recognition Using a Compact Convolutional Neural Network," 2022 1st Computer Engineering Department, Faculty of Engineering, Cyprus International University, 99258 Nicosia, North Cyprus, Mersin 10, Turkey.

II. Sherly Puspha Annabel, "Machine Learning for Plant Leaf Disease Detection and Classification," International Conference on Communication and Signal Processing, April 4-6, 2019, India.

III. H. Q. Cap, K. Suwa, E. Fujita, S. Kagiwada, H. Uga and H. Iyatomi, "A deep learning approach for onsite plant leaf detection," 2018 IEEE 14th International Colloquium on Signal Processing & Its Applications (CSPA), Penang, Malaysia, 2018, pp.118-122. doi: 10.1109/CSPA.2018.8368697