Project Synopsis
on

PLANT DISEASE PREDICTION

Submitted as a part of the course curriculum for

Bachelor of Technology
in
Computer Science

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DECLARATION

We hereby declare that this submission is our work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled "**Tomato Disease Prediction**" which is submitted by **Harsh Srivastava, Yash Srivastava, Sejal Gupta** in partial fulfilment of the requirement for the award of degree B. Tech. in Department of Computer Science of Dr A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

Date:

Supervisor Signature

Prof. Raj Kumar

(Additional Head-CS)

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Last but not the least, we acknowledge our friends for their contribution to the completion of the project.

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ABSTRACT

Today`s era is an era of scientific development. Technologies and new ways of solving real-life problems are being invented every day. With the increasing population of the world, the basic need for food is increasing. That's why agriculture plays an important role all over the world. But due to a lack of proper cultivating knowledge, experience, and a sense of disease prediction, sometimes those cultivating crops and grains get damaged partially or even completely. Of course, that ends up with a huge loss for the farmers as well as for the economic growth of the country. More specifically, it happens to combine the agricultural sector with computer science. Since agriculture is a vast sector to work on, to simplify the work, we are detecting vegetable plant diseases using artificial intelligence and computer science. To implement this idea, we have chosen "tomato" as the core vegetable whose leaf diseases are to be predicted by using the algorithms of artificial intelligence, CNN, and Computer vision. Tomatoes are a very popular vegetable in our country as well as in the world. The main motive is to solve the disease detection problems that tomato growers are facing nowadays on their cultivable land. And that is why we have chosen ' Tomato' leaf disease prediction, which is very important. In this study, nine classes of tomato leaf disease have been detected, including one healthy class. Farmers can input the symptoms in the form of images of affected tomato leaves and it will predict the diseases. It is regarded as an easy-to-use system that will assist vegetable farmers, particularly "tomato" growers, in reducing insect suppression by detecting leaf diseases and increasing yield by expanding opportunities for various vegetable disease research and professional marketplace.

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INTRODUCTION

1.1. Introduction

Tomatoes thrive on practically any well-drained soil and 9/10 farmers grow tomatoes in their fields. Many gardeners also plant tomatoes in their gardens so they may utilize them fresh in their kitchens and enjoy a delicious meal. However, sometimes farmers and gardeners are unable to accurately track the growth of the plants. The tomatoes may occasionally fail to ripen or develop unsightly, disease-filled black blotches at the bottom of the plant. To identify a tomato plant illness, first determine which parts of the plant are infected, then search for differences like brown or black patches and holes in the plant, and last check for insects. Tomatoes and related vegetables, such as potatoes or brinjal, cannot be grown on the same farm more than once in a three-year period. Wheat, corn, rice, sugarcane, etc. should preferably be planted before tomatoes in order to maintain the soil's fertility The 16 illnesses caused by bacteria, fungi, or bad agricultural practices may be split into two categories, while the five additional diseases caused by insects can be categorized as well. Bacterial wilt is a devastating disease caused by the bacterium Ralstonia solanacearum. This bacterium has a long lifespan in soil and can penetrate roots through wounds created naturally during the formation of secondary roots, wounds created artificially during cultivation or transplanting, or even by insects. Disease development is favored by high temperatures and moisture levels. The bacteria swiftly spread inside the plant's water-conducting tissue, filling it with slime. While the leaves may continue to be green, this has an impact on the plant's vascular system. An infected plant stem appears brown in a cross-section with yellowish stuff pouring out of it. After examining the photos of the leaves, we have suggested a novel technique for locating the disease in tomato crops. Without chasing after plant scientists, the work will help farmers identify plant diseases. They will be able to quickly treat the plant illness, which will improve the quality and quantity of food crops produced and, in turn, raise farmer profits. We downloaded the tomato leaves dataset from "Tomato leaf disease detection" for the experiment's purposes. We used a CNNs model to categorize the photos after downloading the dataset. The effectiveness of the model has been examined in relation to several characteristics, including training accuracy, validation accuracy, testing accuracy, and the number of trainable and trainable parameters. The tomato problems is also divided into two sections: bacteria or fungi or poor cultivation habits causing 16 diseases while insects causing 5 other styles of diseases. Ralstonia solanacearum bacteria causes a heavy type of Bacterial wilt. This bacteria can survive in soil for an extended period of time and enter roots through natural wounds made during secondary roots emergence or artificial during cultivating or transplanting or perhaps insects. Tomatoes and similar vegetables like potatoes or brinjal must not be planted on the identical farm for quite just once in an exceedingly period of three years. to take care of the fertility of soil we should always ideally precede tomato planting by any member of the liliopsid family e.g. wheat, corn, rice, sugarcane etc. In the research article, we've proposed a completely unique method to spot the disease in tomato crops after analyzing the pictures of leaves. The work will solve farmers' problems of plant’s disease identification without running after plant scientists. it'll thus help them cure the plant’s disease during a timely fashion and can thus increase both quality and therefore the quantity of food crops produce and thus help in increasing farmer’s profit.

1.2. Problem Statement

Agriculture is an integral part of the Indian economy. The Indian agriculture sector employs nearly half of the country's workforce. India is the second largest producer of Tomatoes in the world. Farmers' economic growth is determined by the quality of the goods they make, which is dependent on plant growth and yield. As a result, in the field of agriculture, disease identification in plants is important. Plants are highly susceptible to diseases that inhibit plant development, which has an effect on the farmer's ecology. The use of an automated disease detection technique is advantageous in detecting a plant disease at an early stage. Plant diseases manifest themselves in various parts of the plant, such as the leaves. It takes a long time to manually diagnose plant disease using leaf photographs. As a result, computational methods must be developed to automate the process of disease detection and classification using leaf images.

1.3. Objective

- To study the existing tomato crop disease that can detect disease in Tomatoes by their leaves accurately and detect unhealthy regions of plant leaves.
- Classification of plant leaf diseases using texture features and analyzes the leaf infection.
- To give remedy information to the user.
- To make these services available on Mobile App this can run on low-level configuration devices.

LITERATURE REVIEW

Crop diseases are a noteworthy risk to sustenance security, however their quick distinguishing proof stays troublesome in numerous parts of the world. Emergence of accurate techniques in the field of leaf-based image classification has shown impressive results. Using machine learning to train the large data sets available publicly gives us a clear way to detect the disease present in plants on a colossal scale. Various modern technologies have emerged to minimize postharvest processing, to fortify agricultural sustainability and to maximize the productivity. Various approaches such as machine learning and deep learning algorithm has been employed to increase the recognition rate and the accuracy of the results. The histogram of oriented gradients (HOG) is an element descriptor utilized as a part of PC vision and image processing for the sake of object detection. Preprocessing involves bringing all the images size to a reduced uniform size. Then comes extracting features of a image which is done with the help of HOG. HOG is a feature descriptor used for object detection. In this feature descriptor the appearance of the object and the outline of the image is described by its intensity gradients. The objective of this algorithm is to recognize abnormalities that occur on plants in their greenhouses or natural environment. The algorithm was contrasted with other machine learning models for accuracy. Using Random forest classifier, the model was trained using 160 images of papaya leaves. The model could classify with approximate 70 % accuracy.[1]

In this project, we have described the technique for the detection of plant diseases with the help of their leaves pictures. Image processing is a branch of signal processing which can extract the image properties or useful information from the image. The proposed solution for plant disease detection is computationally less expensive and requires less time for prediction than other deep learning-based approaches since it uses statistical machine learning and image processing algorithm. The dataset consists of 87000 RGB images of healthy and unhealthy plant leaves having 38 classes out of which We have selected only 25 classes for experimentation of our algorithm. Image is first converted to HSV color space and we have calculated the ratio of number of pixels having pixel intensity of hue (H) channel in between 30 and 70. Image segmentation shape, texture and color features are extracted from the image. Contours are the line that joins all the points along the edges of objects having same color or intensity. Random forest classifier has been used for classification or detection task. They have successfully developed a computer vision based system for plant disease detection with average 93% accuracy. [2]

Advances in computer vision models offer fast, normalized, and accurate answers to these problems. Both apps excel at sharing skills with customers as well as building intuitive online social communities In Recent Years, Deep Learning has led to great performance in various fields like Image Recognition, Speech Recognition, and Natural Language Processing.
The use of the Convocational Neural Network in the Problem of Plant Disease Detection has very good results. We Consider the Neural Architecture namely faster Region-Based Convolutional Neural networks (Faster R-CNN), Region-based Convolution Neural Networks(R-FCN), and single-shot Multi box detector (SSD). We use Plant Village Dataset. The Plant Village dataset consists of 54303 healthy and unhealthy leaf images divided into 38 categories by species and disease. Though datasets may contain anywhere from hundreds to a couple of thousand training examples, the variety might still not be enough to build an accurate model. Some of the many image augmentation options are flipping the image

vertically/horizontally, rotating through various angles and scaling the image. These augmentations help increase the relevant data in a dataset. Protecting crops in organic farming is not an easy task.[3]

Image processing techniques may be used to automatically detect illnesses in leaves, saving time, money, and effort as compared to traditional methods. The early detection of illnesses in leaves improves crop productivity. Disease-affected leaves may be found at an early stage using image processing techniques like as segmentation, identification, and classification, and crop yield and quality can be improved. The technique is more accessible and less costly when plant illness is detected using leaf symptoms. It takes less time, effort, and precision to use an automated detection technique. Image processing technology can quickly and accurately diagnose illnesses based on their features. The visual noise of the tomato leaf is made up of dewdrops, dust, and insect feces on the plants. The input RGB image is transformed to a grayscale image for accurate results to remedy these concerns Image Segmentation: The image is simply divided into various things or sections. It analyses visual data to extract information that may be used for further processing Machine learning and image processing technology benefits from traditional manual diagnostic and recognition procedures for crop disease diagnosis. Computer vision is one of the many fields where deep learning is used. [4]

Tomato is one of the most essential and consumable crops in the world. Leaf disease is the primary factor impacting the amount and quality of crop yield .As a result, it is critical to diagnose and classify these disorders appropriately .Earlier identification of these diseases would reduce the disease's effect on tomato plants and enhance good crop yield. Different innovative ways of identifying and classifying certain diseases have been used extensively. The motive of work is to support farmers in identifying early-stage diseases accurately and informing them about these diseases. The Convolutional Neural Network (CNN) is used to effectively define and classify tomato diseases. Google Collab is used to conduct the complete experiment with a dataset containing 3000 images of tomato leaves affected by nine different diseases and a healthy leaf. The findings demonstrate that the proposed model predictions are 98.49% accurate. The article discussed a deep neural network model for detecting and classifying tomato plant leaf diseases into predefined categories. It also considered morphological traits such as color, texture, and leaf edges of the plant. This article discussed biotic diseases caused by fungal and bacterial pathogens, specifically blight, blast, and browns of tomato leaves. The proposed model detection rate was 98.49 percent accurate. With the same dataset, the proposed model was compared to VGG and ResNet versions. The proposed approach for identifying tomato disease is a ground-breaking notion. In the future, we will expand the model to include certain abiotic diseases due to the deficiency of nutrient values in the crop leaf. Our long-term objective is to increase unique data collection and accumulate a vast amount of data on several diseases of plants.[5]

Tomato is one of the most essential and consumable crops in the world Leaf disease is the primary factor impacting the amount and quality of crop yield. Different kinds of diseases influence the production of tomatoes. Earlier identification of these diseases would reduce the disease's effect on tomato plants and enhance good crop yield. Different innovative ways of identifying and classifying certain diseases have been used extensively.The motive of work is to support farmers in identifying early-stage diseases accurately and informing them about these diseases.The Convolutional Neural Network (CNN) is used to effectively define and classify tomato diseases.Google Colab is used to conduct the complete experiment with a dataset containing 3000 images of tomato leaves affected by nine different diseases and a healthy leaf. The complete process is described: Firstly, the input images are preprocessed, and

the targeted area of images are segmented from the original images. This article discussed biotic diseases caused by fungal and bacterial pathogens, specifically blight, blast, and browns of tomato leaves.The proposed model detection rate was 98.49 percent accurate. With the same dataset, the proposed model was compared to VGG and ResNet versions. After analyzing the results,the proposed model outperformed other models. The proposed approach for identifying tomato disease is a ground-breaking notion. In the future, we will expand the model to include certain abiotic diseases due to the deficiency of nutrient values in the crop leaf. Our long-term objective is to increase unique data collection and accumulate a vast amount of data on several diseases of plants. To improve accuracy, we will apply subsequent technology in the future. In this paper, an improved Yolo V3 algorithm is proposed to detect tomato diseases and insect pests.[6]

Early detection of plant diseases using computer vision and artificial intelligence (AI) can help to reduce the adverse effects of diseases and also helps to overcome the shortcomings of continuous human monitoring. In this study, we have extensively studied the performance of the different state-of-the-art convolutional neural networks (CNNs) classification network architectures i.e. ResNet18, MobileNet, DenseNet201, and InceptionV3 on 18,162 plain tomato leaf images to classify tomato diseases. The comparative performance of the models for the binary classification (healthy and unhealthy leaves), six-class classification (healthy and various groups of diseased leaves), and ten-class classification (healthy and various types of unhealthy leaves) are also reported. InceptionV3 showed superior performance for the binary classification using plain leaf images with an accuracy of 99.2%. DenseNet201 also outperforms six-class classification with an accuracy of 97.99%. Finally, DenseNet201 achieved an accuracy of 98.05% for ten-class classification. It can be concluded that deep architectures performed better at classifying the diseases for the three experiments. The performance of each of the experimental studies reported in this work outperforms the existing literature .The stages of the process into the infinite possibilities of machine learning for agriculture applications, complete with case studies. ResNet, MobileNet, DenseNet201, and InceptionV3 are examples of state-of-the-art pre-trained CNN models that do excellent work of classifying diseases from plant leaf images. When compared to other architectures, the DenseNet201 was found to be better at extracting discriminative features from images. The trained models can be used to detect plant diseases early and automatically. As a result, preventive actions can be adopted faster. This research could help with early and automated disease detection in tomato crops, due to the use of cutting-edge technology like smartphones, drone cameras, and robotic platforms. The proposed structure can be combined with a feedback system that provides appropriate insights, treatments, disease prevention, and control techniques, resulting in improved crop yields.[7]

Agriculture provides food to all the human beings even in case of rapid increase in the population. It is recommended to predict the plant diseases at their early stage in the field of agriculture is essential to cater the food to the overall population. But it unfortunate to predict the diseases at the early stage of the crops. The idea behind the paper is to bring awareness amongst the farmers about the cutting-edge technologies to reduces diseases in plant leaf. Since tomato is merely available vegetable, the approaches of machine learning and image processing with an accurate algorithm is identified to detect the leaf diseases in the tomato plant. In this investigation, the samples of tomato leaves having disorders are considered. With these disorder samples of tomato leaves, the farmers will easily find the diseases based on the early symptoms.The extracted features are classified using machine learning approaches such as Support Vector Machine (SVM), Convolutional Neural Network (CNN) and K-Nearest Neighbor (K-NN). The accuracy of the proposed model is tested using SVM (88%), K-NN

(97%) and CNN (99.6%) on tomato disordered samples. The proposed model uses computer vision techniques including RGB conversion to gray, HE, K-means clustering, contour tracing is employed in preprocessing stage. The multiple descriptors Discrete Wavelet Trans- form, Principal Component Analysis and GLCM are used to extract the informative features of the leaf samples. The machine learning approaches such as SVM, K-NN and CNN are used to distinguish diseased or non-diseased leaf. In future, the model can be improved using fusion techniques for extraction of significant features and examined for other leaf samples of datasets.[8]

Undoubtedly, agriculture is an essential source of livelihood, which stands as a backbone of Indian economy. The plant production is severely affected due to various kinds of diseases, which if accurately and timely detected, could raise health standards and economic growth significantly. The traditional approaches of disease detection and classification involves an immense amount of time, an intense amount of labor and constant monitoring of the farm. By using disease detection methods, diseases caused by bacteria, viruses and fungi are often avoided. Within the upkeep of agricultural goods, crop protection plays a critical role. The various machine learning algorithms used to determine whether a plant is infected or not with a disease, are discussed in this study. It was done in various steps, such as image acquisition, feature extraction, categorization of the illness and result display.The aim is to identify the plant diseases using image analysis. It also, after detection of the illness, says the name of fertilizer to be used. The pests and insects accountable for the pandemic are also described. In this review, a relative investigation is developed on 4 kinds of machine learning classifiers for plant identifying diseases. When compared to other classifiers, many authors use the SVM classifier for the classification of diseases. The outcome shows that more diseases are detected with high accuracy by the CNN classifier. In the future, Naïve Bayes classification can only be used for the identification of diseases in crops and in the way of helping people to detect automatically all types of diseases in crops by the other classifiers machine learning methods such as decision tree.[9]

Plant diseases and pests are important factors determining the yield and quality of plants. Plant diseases and pests identification can be carried out by means of digital image processing. In recent years, deep learning has made breakthroughs in the field of digital image processing, far superior to traditional methods. How to use deep learning technology to study plant diseases and pests identification has become a research issue of great concern to researchers. This review provides a definition of plant diseases and pests detection problem, puts forward a comparison with traditional plant diseases and pests detection methods. According to the difference of network structure, this study outlines the research on plant diseases and pests detection based on deep learning in recent years from three aspects of classify cation network, detection network and segmentation network. This study gives the analysis and prospect of the future trend of plant diseases and pests detection based on deep learning. Compared with traditional image processing methods, which deal with plant diseases and pests detection tasks in several steps and links, plant diseases and pests detection methods based on deep learning unify them into end-to-end feature extraction, which has a broad development prospects and great potential. Although plant diseases and pests detection technology is developing rapidly, it has been moving from academic research to agricultural application, there is still a certain distance from the mature application in the real natural environment, and there are still some problems to be solved.[10]

GAPS IN LITERATURE

At present, the research on plant diseases and pests based on deep learning involves a wide range of crops, including all kinds of vegetables, fruits and food crops. The tasks completed include not only the basic tasks of classification, detection and segmentation, but also more complex tasks such as the judgment of infection degree. At present, most of the current deep learning-based methods for plant diseases and pests detection are applied on specific datasets, many datasets are not publicly available, there is still no single publicly available and comprehensive dataset that will allow all algorithms to be uniformly compared. With the continuous development of deep learning, the application performance of some typical algorithms on different datasets has been gradually improved, and the mAP, F1 score and FPS of the algorithms have all been increased. The breakthroughs achieved in the existing studies are amazing, but due to the fact that there is still a certain gap between the complexity of the infectious diseases and pests images in the existing studies and the real-time field diseases and pests detection based on mobile devices. Subsequent studies will need to find breakthroughs in larger, more complex, and more realistic datasets.

Exhaustive surveys have been conducted where the limitations of current methods for plant disease detection are summed up. Each of them listed the following challenges:

- data scarcity
- using images acquired in real conditions
- more accurate classification of the disease
- disease stage identification

The complex background is another issue that should be considered when creating the dataset. Computational complexity and memory requirements also deserve special attention. It is still a challenging task to detect simultaneous disorders and to capture images in all of the possible conditions. However, they highlight that it is unrealistic to expect that an automatic disease recognition system can achieve perfect accuracy when used in field conditions.

PROPOSED METHODOLOGY

3.1 Flowchart

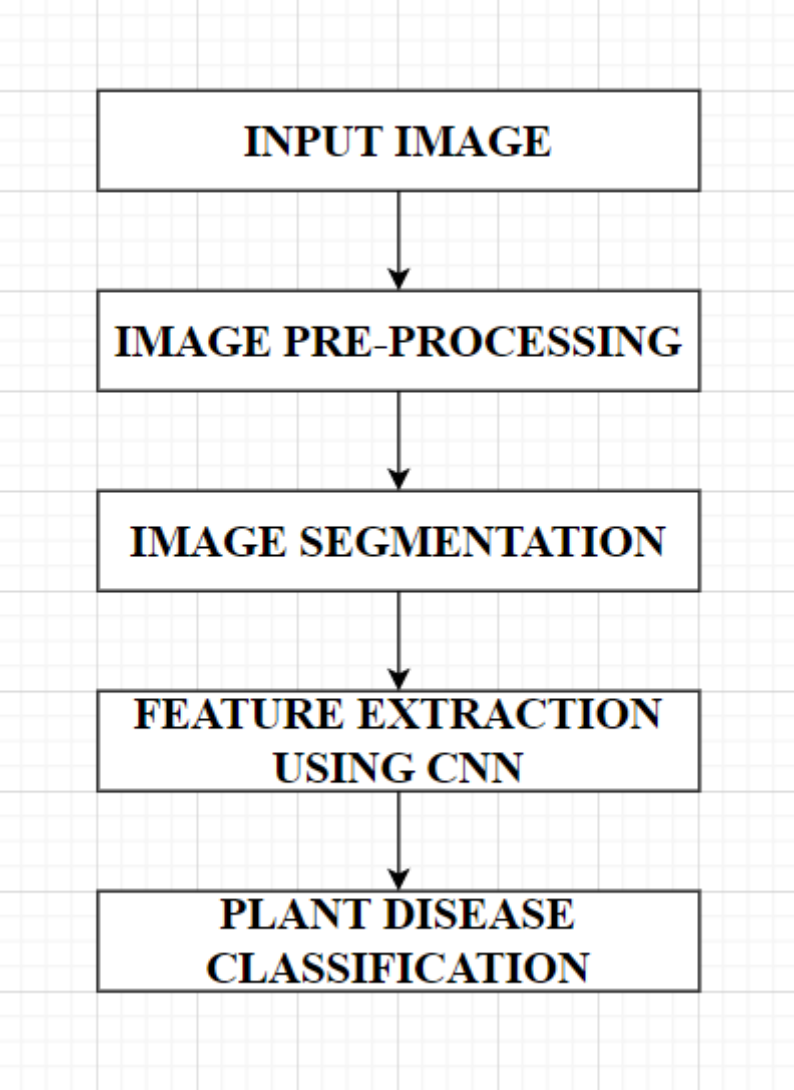

Fig.1.Flowchart

3.2 Dataset To Be Used

- The Dataset is collected from open-source website "Kaggle".
- Dataset contains 11k images of 9 tomato disease and 1 healthy class.
- Hence the dataset contains 10 classes of tomato leaves.
- Link: https://www.kaggle.com/datasets/kaustubhb999/tomatoleaf

The data has different types of diseases for tomato leaves.

Here goes the list:

- Tomato mosaic virus
- Target Spot
- Bacterial spot
- Tomato Yellow Leaf Curl Virus
- Late blight
- Leaf Mold
- Early blight
- Spider mites
- Tomato healthy
- Septoria leaf spot

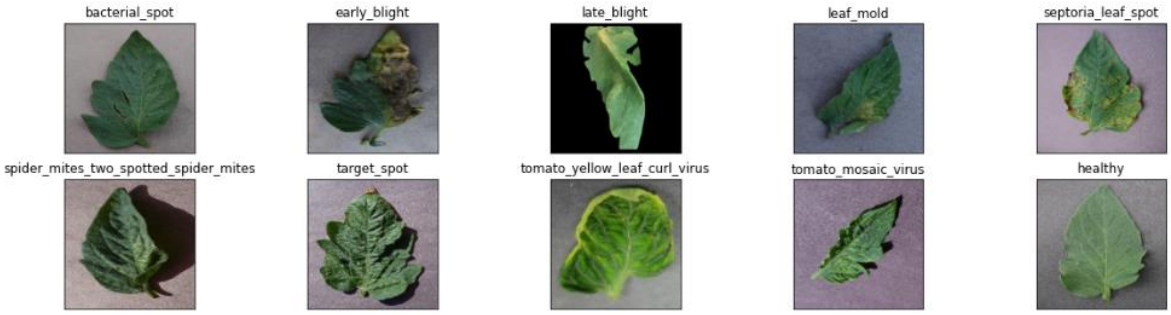

Fig.2. Sample Dataset [10]

TECHNOLOGY USED

4.1 Libraries to be Used

- Tensorflow
- Scikit-learn
- Keras
- Numpy
- Pandas
- Open-CV
- Matplotlib

4.2 List of module

- Image acquisition.
- Image pre-processing.
- Image segmentation.
- Image analysis.
- Feature extraction.
- Disease classification.

Image Acquisition:

The first step is to gather data from a publicly accessible repository. The picture is used as the input for further processing. We've chosen the most common image domains so that we can accept any format as input to our method, including.jpeg, .jpg, and .png. The camera feeds the real-time images directly. Since most leaves colour varies from red to green for exact segmentation, a white background is provided for further study, proper visibility, and easy image analysis.The picture is taken in such a way that any distortion is avoided. The photo was not taken in direct sunlight because it would distort the picture.

Image Pre-processing:

The use of computer algorithms to perform image processing on digital images is known as image pre-processing. We can detect the plant by analysing the image with a specific algorithm. We use a similar approach for image processing and detection with a specific algorithm. The image quality is critical in this process; we can't use the algorithm if the image isn't clear.

Image Segmentation:

The use of computer algorithms to perform image processing on digital images is known as image pre-processing. We can detect the plant by analysing the image with a specific algorithm. We use a similar approach for image processing and detection with a specific algorithm. The image quality is critical in this process; we can't use the algorithm if the image isn't clear

Image Analysis:

In this step, image segmentation is used to locate the region of interest. The technique used in segmentation is region-based segmentation, which uses the colour of the leaf to distinguish between healthy and diseased regions of the plant leaf.

Feature Extraction:

Feature extraction is a part of the dimensionally reduction method in machine learning, which divides and reduces a large collection of raw data into smaller classes. When we have a large amount of data and need to minimise the number of resources while avoiding errors, this step is critical. As a result, function extraction aids in the extraction of the best feature from large data sets by selecting and combining variables into functions.

Disease Classification:

It is the method of using our qualified deep learning model to recognise plant disease. A digital camera or equivalent system should be used to take an image of the contaminated plant's leaf. Opencv was used to scan the image. Then it determines what kind of plant it is. It determines what kind of disease the plant has after finding it.

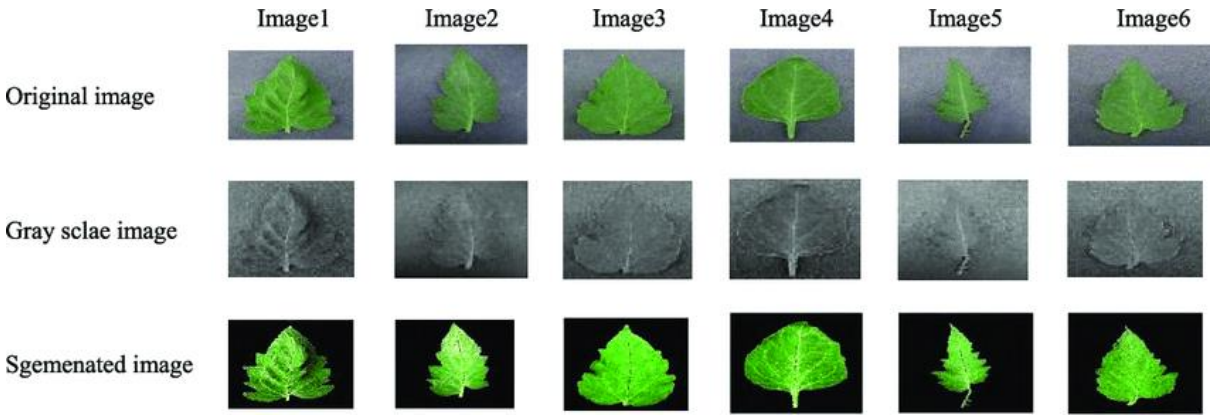

Fig.3. Image Segmentation of a Tomato Leaf

EXPECTED OUTCOME

The proposed system tracks the cultivated field on a regular basis. The CNN algorithms are used to identify Tomato crop diseases at an early stage. Machine learning methods are used to train the model, which aids in making appropriate disease decisions. To contain infected diseases, the farmer is advised to use pesticides as a cure. In the future, the proposed scheme could be expanded to provide additional facilities such as nearby government markets, pesticide price lists, and a nearby open market, among others. This paper presents a review of various disease classification strategies for crop disease detection, as well as an algorithm for image segmentation that can be used for automated detection and classification of plant leaf diseases in the future. Some of the organisms on which the proposed algorithm is evaluated include banana, beans, jackfruit, lemon, mango, potato, and sapota. As a result, similar diseases for these plants were investigated. The best results were obtained with very little computational effort, demonstrating the efficacy of the proposed algorithm in recognising and classifying crop diseases. Another benefit of this approach is that plant diseases can be detected at an early stage, or even at the beginning. Convolution neural network and Deep neural network algorithms may be used to increase recognition rates in the classification process.

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