Plant Disease Detection

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Certificate

This is to certify that this Project Report titled **Plant Disease Detection** submitted in partial fulfillment of requirements for award of the degree Bachelor of Technology (B.Tech.) in Computer Science Engineering of Maulana Abul Kalam Azad University of Technology is a faithful record of the original work carried out by.

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Declaration

We hereby declare that this project report titled Plant Disease Detection is our own original work carried out as a under graduate student in Netaji Subhash Engineering College except to the extent that assistances from other sources are duly acknowledged.

All sources used for this project report have been fully and properly cited. It contains no material which to a substantial extent has been submitted for the award of any degree/diploma in any institute or has been published in any form, except where due acknowledgement is made.

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Acknowledgement

We acknowledge that the project titled as **Plant Disease Detection** is our own original work. We have learnt about the basics of designing software and thereafter we have gathered knowledge about structuring job role specific interfaces. Conducting this project helped us to learn about collecting relevant data and also taught us team work.

We would like to thank our guide Asst. Prof. Runa Chatterjee for guiding us through this enlightening journey and teaching us the framework behind this project.

We would also like to take this opportunity to express my gratitude to all Professors who have helped us to gain knowledge and concepts about the subjects. We could not have successfully completed the project without their cooperation and inputs.

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ABSTRACT

Artificial Intelligence has been witnessing a monumental growth in bridging the gap between the capabilities of humans and machines. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm that can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. In our base paper image segregation and identification is done using matrix factorization and machine learning. But this create a trained model using a Convolutional Neural Network where the user-given image is detected by converting and comparing the images which are in matrix form. In our application, the user image is compared with our trained model to identify the specifics of images and sent to the client where machine learning helps to find the right fertilizers for the crop based on disease recognized in the image given by the user in the first place. This proposed method is way efficient and effective compared to traditional image recognition. And our application use weather report for any given location and soil report - suggestion for the cultivation of specific crops for best productivity

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CHAPTER 1

INTRODUCTION

This application plays a vital role in recognizing the crop's leaves image and finding out the disease cause and fertilize suggestions after comparing with the trained model using Convolution Neural Network helps to differentiate each image by converting them by process of matrix convolution. CNN represents an interesting method for adaptive image processing and forms a link between general feed-forward neural networks and adaptive filters. Any user who grows different crops may not know all the diseases caused by fungus and bacteria. By uploading, their affected crops leave users to benefit by understanding the disease name and cause then our client can suggest fertilizer by analyzing the composition between modeled images and user images. Our application creates a good environment for fertilizer suggestions and two more important processes where the user can have weather and soil reports.

Based on the location given by the user, a weather report is generated and a soil report contains the suggested crops to grow by the user based on the soil samples given by the user. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. The problem of efficient disease protection is closely associated with the problems of sustainable agriculture Inexperienced pesticide usage can cause the event of long-term resistance of the pathogens, severely reducing the power to fight back. Timely and accurate diagnosis of plant diseases is one among the pillars of precision agriculture. It is crucial to stop unnecessary waste of monetary and other resources, thus achieving healthier production during this changing environment, appropriate and timely disease identification including early prevention has never been more important. There are several ways to detect plant pathologies. Some diseases do not have any visible symptoms, or the effect becomes noticeable too late to act, and in those situations, a classy analysis is obligatory. However, most diseases generate some quite manifestation within the visible spectrum, therefore the eye examination of a trained professional is that the prime technique adopted in practice for disease detection.

To achieve accurate disease diagnostics a plant pathologist should possess good observation skills in order that one can identify characteristic symptoms. Variations in symptoms indicated by diseased plants may lead to an unsuitable diagnosis since unprofessional gardeners and hobbyists could have more difficulties determining it than knowledgeable plant pathologist. an automatic system designed to assist identify plant diseases by the plant’s appearance and visual symptoms might be of great help to amateurs within the gardening process and trained professionals as a confirmation system in disease diagnostics. One of the main parts of Neural Networks is Convolutional neural networks (CNN). CNNs use image recognition and classification in order to detect objects, recognize faces, etc.

They are made up of neurons with learnable weights and biases. Each specific neuron receives numerous inputs and then takes a weighted sum over them, where it passes it through an activation function and responds back

with an output. CNNs are primarily used to classify images, cluster them by similarities, and then perform object recognition. Many algorithms using CNNs can identify Plant disease, faces, street signs, animals, etc. Plant diseases can cause great damage

to agricultural crops by significantly reducing their production because they restrict the growth of crops and lead to poor quality of products. Due to its lower yield and fiber, biofuel crops as agriculture struggles to keep up with the world's rapidly increasing population. An existing method for the detection and identification of plant leaf diseases is observed with the naked eye . Additionally, plants must be monitored in a consistent manner to avoid the spread of disease. Diseases, pests, and other undesirable substances present in crops can cause a sharp decline in agricultural production . The impact of these dangerous factors on crops has a direct impact on the decline of the quality and quantity of crops. To combat, control, and mitigate the effects of biological organisms and diseases. However, most diseases generate some kind of manifestation in the visible spectrum, so the naked eye examination of a trained professional is the prime technique adopted in practice for plant disease detection.

1.1 CONVOLUTIONAL NEURAL NETWORK ALGORITHM

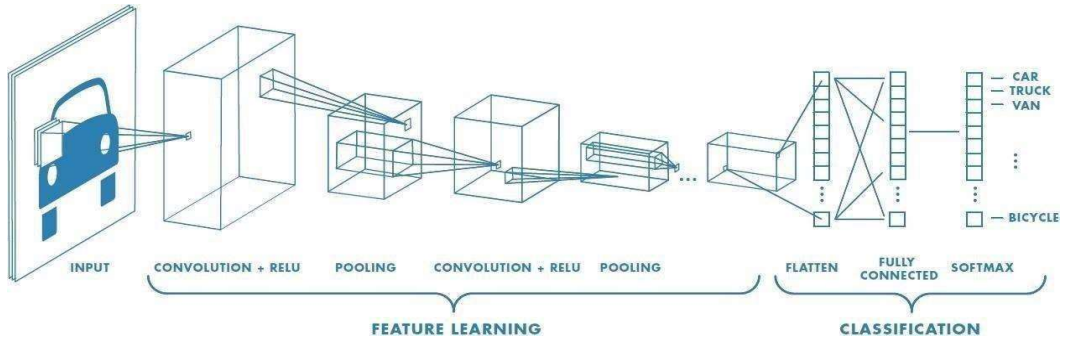


Fig 1.1: Feature Learning and Classification

Artificial Intelligence has been witnessing a monumental growth in bridging the gap between the capabilities of humans and machines. Researchers and enthusiasts alike, work on numerous aspects of the field to make amazing things happen. One of many such areas is the domain of Computer Vision.

The agenda for this field is to enable machines to view the world as humans do, perceive it in a similar manner and even use the knowledge for a multitude of tasks such as Image & Video recognition, Image Analysis & Classification, Media Recreation, Recommendation Systems, Natural Language Processing, etc. The advancements in Computer Vision with Deep Learning has been constructed and perfected with time, primarily over one particular algorithm-a Convolutional Neural Network.

They have applications in image and video recognition, recommender systems, image classification, image segmentation, medical image analysis, natural language processing, brain–computer interfaces, and financial time series. CNNs are regularized versions of multilayer perceptrons. Multilayer perceptron’s usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer. The "full connectivity" of these networks makes them prone to overfitting data.

1.2 SOFTWARE PROGRAMING TOOL

PyCharm is hybrid platform developed by JetBrains as an IDE for Python. It is commonly used Python application development. Some of the unicorn organizations such as Twitter, Facebook, Amazon, and Pinterest use PyCharm as their Python IDE. We can run PyCharm on Windows, Linux, or Mac OS. Additionally, it contains modules and packages that help programmers develop software using Python in less time and with minimal effort. Further, it can also be customized according to the requirements of developers.

1.2.1 **Features of PyCharm**

Intelligent Code Editor

- It helps us write high-quality codes!
- It consists of color schemes for keywords, classes, and functions. This helps increase the readability and understanding of the code.
- It helps identify errors easily.
- It provides the autocomplete feature and instructions for the completion of the code.

Code Navigation

- It helps developers in editing and enhancing the code with less effort and time.
- With code navigation, a developer can easily navigate to a function, class, or file.
- A program can locate an element, a symbol, or a variable in the source code within no time.
- Using the lens mode, further, a developer can thoroughly inspect and debug the entire source code.

Refactoring

- It has the advantage of making efficient and quick changes to both local and global variables.
- Refactoring in PyCharm enables developers to improve the internal structure without changing the external performance of the code.
- It also helps split up more extended classes and functions with the help of the extract method.

Assistance for Many Other Web Technologies

- It helps developers create web applications in Python.
- It supports popular web technologies such as HTML,CSS, and JavaScript.

- Developers have the choice of live editing with this IDE. At the same time, they can preview the created/updated web page.
- The developers can follow the changes directly on web browser.
- PyCharm also supports AngularJS and NodeJS for developing web applications.

Support for Popular Python Web Frameworks

- PyCharm supports web frameworks such as Django.
- It provides the autocomplete feature and suggestions for the parameters of Django.
- It helps in debugging the codes of Django.
- It also assists web2py and Pyramid, the other popular web frameworks.
- It consists of interactive graphs that help developers understand data.
- It is capable of integrating with various tools such as I Python, Django, and Pytest. This integration helps innovate unique solutions.

1.3 PROGRAM STRUCTURE

Fig. 1.13 WAMPSERVER

WampServer is meant by constituting WAMP + SERVER, now here Wamp is a short form for "**Windows, Apache, MySQL and PHP**" whereas the Server simply means a computer program that provides services to other applications or clients.

Windows which is an ultimate platform for beginners and advanced users to operate, process and manage the different day to day computing tasks, however, if you are a developer and want to experience some of the most powerful software without paying a single penny then you should think about **Linux**. There are so many software packages that are only designed to run efficiently on Linux platforms such as Apache web server, PHP interpreter and MySQL database.

WAMP stands for Windows (operating system), Apache (webserver), MySQL (database), and PHP (coding language). WAMP can be compared to two other close variants, namely:

- LAMP (Linux, Apache, MySQL, and PHP) for Linux Systems.
- MAMP (Mac, Apache, MySQL, and PHP) for Mac OS operating systems. WAMP, therefore, is a localhost server for Windows Operating Systems that lets you manage, create, test, and develop websites without having to use a remote web server.

Let's take *WordPress* as an example. If you want to build a website on the *WordPress* platform, for example, you can use the WAMP server to create a local environment that allows you to work offline.

Here you can experiment with code, plugins, design, as well as test the different features of your website before taking it live. It's important to note that Apache, PHP, and MySQL are all open-source software. This means that you can install and configure each service individually. However, this process is not easy, even for skilled developers. Luckily, a WAMP server automates the configuration process giving you a local working environment in a matter of minutes. With that in mind, now let's look at **how to install a WAMP server**. WampServer also supports phpMyAdmin, MariaDB, Adminer, PhpSysInfo. You don't have to enter complicated SQL statements to manage the MYSQL database, you can manage it directly from phpMyAdmin which provides a graphical user interface to create, manage and delete databases.

Use of WampServer

- In general, developers or users the WampServer for testing various web applications or websites locally before making them live using WAMP. For example, you want to create a website on WordPress but before going ive your website or purchasing hosting you can learn how to install WordPress, setting themes etc. locally using WampServer.
- Apache Web server or Apache HTTP server to allow users testing web pages or apps in Windows browser.
- PHP- Hypertext Pre-processor scripting language for web development and can embedded into HTML.
- Developers or users use the WampServer for testing various web applications or websites locally before making them live using WAMP. For example, you want to create a website on WordPress but before going live your website or purchasing hosting you can learn how to use WampServer.

1.4.1 TENSORFLOW

It is an open-source artificial intelligence library, using data flow graphs to build models. It allows developers to create large-scale neural networks with many layers. TensorFlow is mainly used for: Classification, Perceptron, Understanding, Discovering, Prediction and Creation. TensorFlow is the second machine learning framework that Google created and used to design, build, and train deep learning models.

You can use the TensorFlow library do to numerical computations, which in itself doesn't seem all too special, but these computations are done with data flow graphs. In these graphs, nodes represent mathematical operations, while the edges represent the data, which usually are multidimensional data arrays or tensors, that are communicated between these edges. The name "TensorFlow" is derived from the operations which neural networks perform on multidimensional data arrays or tensors! It's literally a flow of tensors. For now, this is all you need to know about tensors, but you'll go deeper into this in the next sections.

Use Case of TensorFlow:

- Voice/Sound Recognition.
- Texted Based Applications.
- Image Recognition.

Voice/Sound Recognition.

One of the most well-known uses of TensorFlow are Sound based applications. With the proper data feed, neural networks are capable of understanding audio signals. These can be:

- Voice recognition – mostly used in IoT, Automotive, Security and UX/UI
- Voice search – mostly used in Telecoms, Handset Manufacturers
- Sentiment Analysis – mostly used in CRM
- Flaw Detection (engine noise) – mostly used in Automotive and Aviation.

Texted Based Applications.

Further popular uses of TensorFlow are, text-based applications such as sentimental analysis (CRM, social media), Threat Detection (Social Media, Government) and Fraud Detection (Insurance, Finance) Language Detection is one of the most popular uses of text based applications.

We all know Google Translate, which supports over 100 languages translating from one to another. The evolved versions can be used for many cases like translating jargon legalese in contracts into plain language. Text Summarization.

Image Recognition.

Mostly used by Social Media, Telecom and Handset Manufacturers; Face Recognition, Image Search, Motion Detection, Machine Vision and Photo Clustering can be used also in Automotive, Aviation and Healthcare Industries. Image Recognition aims to recognize and identify people and objects in images as well as understanding the content and context. TensorFlow object recognition algorithms classify and identify arbitrary objects within larger images. This is usually used in engineering applications to identify shapes for modelling purposes (3D space construction from 2D images) and by social networks for photo tagging (Facebook's Deep Face).

By analyzing thousands of photos of trees for example, the technology can learn to identify a tree it has never seen before. Image recognition refers to the task of inputting an image into a neural network and having it output some kind of label for that image. The label that the network outputs will correspond to a pre-defined class. There can be multiple classes that the image can be labeled as, or just one. If there is a single class, the term *"recognition"* is often applied, whereas a multi-class recognition task is often called *"classification"*. A subset of image classification is object detection, where specific instances of objects are identified as belonging to a certain class like animals, cars, or people. In order to carry out image recognition/classification, the neural network must carry out feature extraction. Features are the elements of the data that you care about which will be fed through the network. In the specific case of image recognition, the features are the groups of pixels, like edges and points, of an object that the network will analyze for pattern.

1.5 PLANT DISEASES

1.5.1 CEDAR APPLE RUST (APPLE)

FIG: CEDAR APPLE RUST

Cedar apple rust (*Gymnosporangium juniperi-virginianae*) is a fungal disease that requires juniper plants to complete its complicated two-year life-cycle. Spores overwinter as a reddish-brown gall on young twigs of various juniper species. In early spring, during wet weather, these galls swell and bright orange masses of spores are blown by the wind where they infect susceptible apple and crab-apple trees. The spores that develop on these trees will only infect junipers the following year.

From year to year, the disease must pass from junipers to apples to junipers again; it cannot spread between apple trees. On apple and crab-apple trees, look for pale yellow pinhead sized spots on the upper surface of the leaves shortly after bloom. These gradually enlarge to bright orange-yellow spots which make the disease easy to identify. Orange spots may develop on the fruit as well. Heavily infected leaves may drop prematurely. There are some ways by which we can provide treatment of Cedar apple rust:

- Choose resistant cultivars when available.
- Rake up and dispose of fallen leaves and other debris from under trees.
- Remove galls from infected junipers. In some cases, juniper plants should be removed entirely.
- Apply preventative, disease-fighting fungicides labeled for use on apples weekly, starting with bud break, to protect trees from spores being released by the juniper host. This occurs only once per year, so additional applications after this springtime spread are not necessary.
- On juniper, rust can be controlled by spraying plants with a copper solution (0.5 to 2.0 oz/ gallon of water)

at least four times between late August and late October.

- Safely treat most fungal and bacterial diseases with SERENADE Garden. This broad- spectrum bio-fungicide uses a patented strain of *Bacillus subtilis* that is registered for organic use. Best of all, SERENADE is completely non-toxic to honey bees and beneficial insects.

- Containing sulfur and pyrethrins, Bonide Orchard Spray is a safe, one-hit concentrate for insect attacks and fungal problems. For best results, apply as a
- protective spray (2.5 oz/ gallon) early in the season.
- Since the juniper galls are the source of the spores that infect the apple trees, cutting them is a sound strategy if there aren't too many of them. While the spores can travel for miles, most of the ones that could infect your tree **are within a few hundred feet**. The best way to do this is to prune the branches about 4-6 inches below the galls. You will want to disinfect your pruning shears, so you don't spread the infection. Dip them in 10% bleach or alcohol for at least 30 seconds between cuts.
- If your tree has a history of infection with cedar apple rust, you will want to get ahead of the infection and take preemptive measures. This is critical in the spring, when the juniper galls are releasing their spores. The time to treat your tree is between the pink stage of the blossoms (when the leaves are turning green) to the period when the petals drop.

1.5.2 GRAY LEAF SPOT (CORN)

FIG: GRAY LEAF SPOT

Gray leaf spot is the number one disease in all corn production. The fungus survives the winter on residue from the prior corn crop, providing a primary source of the inoculum, particularly when growers plant continuous corn or use a no-till soybean/corn rotation. Spores from the fungus are splashed onto the lower leaves early in the season. When these resulting infections produce spores, the inoculum can be carried by air currents higher into the canopy or into neighboring fields. Mature lesions from gray leaf spot are rectangular, as they are restricted by

the leaf veins.

As every veteran corn producer knows, corn is susceptible to a myriad of foliar fungal diseases. The most aggressive of these diseases, gray leaf spot, has been increasing in economic impact in many regions of the world over the past 10 years. Because gray leaf spot reduces a plant's photosynthetic surface area, the fungus significantly diminishes both the yield and quality of the crop. Field trials have shown potential yield losses from gray leaf spot range from 5 to 40 bu/A; however, losses as high as 100 percent are documented when early blighting of the leaves above the ear leaf occurs.

As reduced tillage became widespread in the 1980s and '90s, gray leaf spot disease grew commonplace in the heart of the Corn Belt. Farmers eager to capitalize on the increasing value and demand for corn augmented the amount of Midwest acreage in continuous corn. Both trends have contributed to an increase in the amount of corn residue in fields—a circumstance that can lead to severe infections the following year. The planting of susceptible hybrids and weather conditions that favor rapid spread of the disease have contributed to the fact that gray leaf spot is now endemic in many regions of the world.

Future yield losses will correlate with environmental conditions and the overwintering of the fungus in crop residue. If the humidity and frequency of heavy rainfall forecasted for many regions of the U.S. materializes, pathogens are expected to become even more problematic. Gray leaf spot initially appears as spots on the leaves that are round or oval, tan in color, and have a dark brown border. When the leaves are wet or humidity is high, the leaf spots turn gray and fuzzy with profuse spore production. In time, the leaf spots expand and girdle the leaf, causing it to die back from the tip. Significant damage to the turf stand may occur as the disease continues to progress.

1.5.3 EARLY BLIGHT (POTATO)

FIG: EARLY BLIGHT

Early blight of potato is caused by the fungal pathogen Alternaria solani. The disease affects leaves, stems and tubers and can reduce yield, tuber size, storability of tubers, quality of fresh-market and processing tubers and marketability of the crop.

In most production areas, early blight occurs annually to some degree. The severity of early blight is dependent upon the frequency of foliar wetness from rain, dew, or irrigation; the nutritional status of the foliage; and cultivar susceptibility. Across the Midwestern U.S., foliar infection is the most problematic phase of the disease, whereas in the western portion of the country, tuber infection can be more damaging. The disease first develops on mature and senescing foliage, and early maturing cultivars are the most susceptible. Potato is the primary host, but the disease also can be severe on tomatoes, and occur on other *solanaceous* plants such as hairy nightshade.

Symptoms of early blight occur on fruit, stem and foliage of tomatoes and stem, foliage and tubers of potatoes. Initial symptoms on leaves appear as small 1-2 mm black or brown lesions and under conducive environmental conditions the lesions will enlarge and are often surrounded by a yellow halo. Lesions greater than 10 mm in diameter often have dark pigmented concentric rings. This so-called “bullseye” type lesion is highly characteristic of early blight (Figure 4). As lesions expand and new lesions develop entire leaves may turn chlorotic and dehisce, leading to significant defoliation. Lesions occurring on stems are often sunken and lens-shaped with a light center, and have the typical concentric rings (Figure 5). On young tomato seedlings lesions may completely girdle the stem, a phase of the disease known as “collar rot,” which may lead to reduced plant vigor or death. Symptoms of early blight occur on fruit, stem and foliage of tomatoes and stem, foliage and tubers of potatoes. Initial symptoms on leaves appear as small 1-2 mm black or brown lesions and under conducive environmental conditions the lesions will enlarge and are often surrounded by a yellow halo (Figures 2 and 3). Lesions greater than 10 mm in diameter often have dark pigmented concentric rings. This so- called “bullseye” type lesion is highly characteristic of early blight.

1.5.4 TOMATO LATE BLIGHT

FIG: TOMATO LATE BLIGHT

Tomato late blight is caused by the oomycete pathogen *Phytophthora infestans(P. infestans).*The pathogen is best known for causing the devastating Irish potato famine of the 1840s,which killed over a million people, and caused another million to leave the country.

The first symptoms of late blight on tomato leaves are irregularly shaped, water- soaked lesions, often with a lighter halo or ring around them; these lesions are typically found on the younger, more succulent leaves in the top portion of the plant canopy. During high humidity, white cottony growth may be visible on underside of the leaf (Figure 2), where sporangia form .

Spots are visible on both sides of the leaves. As the disease progresses, lesions enlarge causing leaves to brown, shrivel and die. Late blight can also attack tomato fruit in all stages of development. Rotted fruit are typically firm with greasy spots that eventually become leathery and chocolate brown in color (Figure 4); these spots can enlarge to the point of encompassing the entire fruit. "*Look alike" diseases*: Other species of *Phytophthora*, specifically *P. nicotiana* and *P. capsici,* can also cause lesions on tomato and tomato fruit similar to those caused by late blight. However, these two species are soilborne (as opposed to ariborne) and typically only cause disease after the plants have been flooded or if the plant had been in contact with wet soil. Late blight can be differentiated from early blight on tomato and other foliar fungal diseases by where they occur on the plant.

Leaf symptoms of late blight first appear as small, water-soaked areas that rapidly enlarge to form purple-brown, oily-appearing blotches. On the lower side of leaves, rings of grayish white mycelium and spore-forming structures may appear around the blotches. Entire leaves die and infections quickly spread to petioles and young stems. Infected fruit turn brown but remain firm unless infected by secondary decay organisms; symptoms usually begin on the shoulders of the fruit because spores land on fruit from above.

CHAPTER 2

A Literature Survey: Plant Leaf Diseases Detection Using Convolutional Neural Network

I. *Introduction*

Developing countries like India the economy mainly depends on agriculture. Due to plant diseases the quality and quantity of agricultural products is reduced. Our application plays a vital role in recognizing the crop's image and finding out the disease's cause and fertilize suggestions after comparing with the trained model using Convolution Neural Network helps to differentiate each image by converting them by process of matrix convolutional. CNN represents an interesting method for adaptive image processing and forms a link between general feed-forward neural networks and adaptive filters. Any user who grows different crops can benefit by understanding the disease name and cause then our client can suggest fertilizer by analyzing the composition between modeled images and user images. Our application creates a good environment for fertilizer suggestion and two more important processes where the user based on the soil samples given by the user. The pre-processing required in ConvNet is much lower as compared to other classification algorithms.

I. Literature Survey

In this section describes various approaches for detecting the disease in plant leaf using image processing technique

Ahmed, K. Shahidi, T.R & et al As one of the top ten rice producing and consuming countries in the world, Bangladesh depends greatly on rice for its economy and for meeting its food demands.

To ensure healthy and proper growth of the rice plants it is essential to detect any disease in time and prior to applying required treatment to the affected plants. Since manual detection of diseases costs a large amount of time and labor, it is inevitably prudent to have an automated system. This paper presents a rice leaf disease detection system using machine learning approaches. Three of the most common rice plant diseases namely leaf smut, bacterial leaf blight and brown spot disease are detected in this work. Clear images of affected rice leaves with white background were used as the input. After necessary pre-processing, the dataset was trained on with a range of different machine learning algorithms including that of KNN(K- Nearest Neighbors), J48(Decision Tree), Naïve Bayes and Logistic Regression. Decision tree algorithm, after 10-fold cross validation, achieved and accuracy of over 97% when applied on the dataset.

Sanga, S.L., D. Machuve., Jomanga, K., & et al In Tanzania, smallholder farmers contribute significantly to banana production and Kagera, Mbeya, and Arusha are among the leading regions. However, pets and diseases are a threat to food security. Early detection of banana diseases is important to identify the diseases before too

much damage is done on the plants. In this paper, a tool for early detection of banana diseases by using a deep learning approach is proposed. Five deep learning architectures, namely Vgg16, Resnet18, Resnet50, Resnet152 and InceptionV3 were used to develop models for banana diseases detection, achieving all high accuracies, varying from 95.41% for InceptionV3 to 99.2% for Resent152. InceptionV3 was selected for mobile deployment because it demands much less memory. The developed tool was capable of detecting diseases with a confidence of 99% of the captured leaves from the real environment. This tool will help smallholder farmers conduct early detection of banana diseases and improve their productivity.

Saleem, Khanchi, Potgieter, & et al Features are the vital factor for image classification in the field of machine learning. The advancement of deep convolutional neural networks(CNN) shows the way for identification of rice diseases using deep features with the expectation of high returns. This technology introduced 5932 on-field images of four types of rice leaf diseases, namely bacterial blight, blast, brown spot and tungro. In addition, the performance evaluation of 11 CNN models in transfer learning approach and deep feature plus support vector machine (SVM) was carried out. The simulation results show the deep feature plus SVM perform better classification compared to the transfer learning counterpart. Also, the performance of small CNN models such as mobilenetv2 and shuffle net was examined. The performance evaluation was carried out in terms of accuracy, sensitivity, specificity, false positive rate (FPR), F1 Score and training time. Again, the statistical analysis was performed to choose the better classification model.

Adit, Rubesh, Bharathi, Santhiya, and Anuradha & et al The biotic stress of agricultural crops is a major concern across the globe. Its major effects are felt in economically poor countries where advanced facilities for diagnosis of a disease are limited as well as lack of awareness among the farmers. A recent revolution in smartphone technology and deep learning techniques have created an opportunity for automated classification of disease. In this study images acquired through smartphones are transmitted to a personal computer via wireless Local Area Network (LAN) for classification of ten different diseases using transfer learning in four major agricultural crops which are least explored. Six pre-trained Convolutional Neural Networks(CNN) have been used namely Alex Net, Visual Geometry Group 16(VGG16), VGG19, Google Net , ResNet101 and DenseNet201 with their corresponding results explored. Google Net resulted in the best validation accuracy of 97.3%. The misclassification was mainly due to Tobacco Mosaic Virus(TMV) and two-spotted spider mite. In test conditions, images were classified in real- time and prediction scores have been evaluated for each disease class. It depicted a reduction in accuracy in all models with VGG16 resulting in the best accuracy of 90%.

Loey, ElSawy, Afify & et al Apart from being relied upon for feeding the entire world, the agricultural sector is also responsible for a third of the global Gross- Domestic- Product (GDP). Additionally, a majority of opportunities for a significant fraction of the poor. This calls for methods to ensure the accurate and efficient diagnosis of plant disease, to minimize any adverse effects in the product. This paper proposes the recognition

and classification of maize plant leaf diseases by application of the Deep Forest algorithm. The Automated novel approach and accurate classification using the Deep Forest technique are a significant step-up from the existing manual classification and other techniques with less accuracy. The proposed approach has outperformed Deep Neural models and other traditional machine learning algorithms in terms of accuracy. It justifies its low dependency on extensive Hyper-parameter tuning and the size of the dataset as against other Deep Learning Models based on neural networks.

Chalapathy, Chawla & et al Plant leaves can be used to effectively detect plant diseases. However, the number of images of unhealthy leaves collected from various plants is usually unbalanced. It is difficult to detect diseases using such an unbalanced dataset. We used Double GAN (a double generative adversarial network) to generate images of unhealthy plant leaves to balance such datasets. We proposed using Double GAN is divided into two stages. In stage 1, we used healthy leaves and unhealthy leaves as inputs. First, the healthy leaf images were used as inputs for the WGAN (Wasserstein generative adversarial network) to obtain the pretrained model. Then, unhealthy leaves were used for the pretrained model to generate 64*64 pixel images of unhealthy leaves.

Abbas, A,; Jain, S,; Gour, M,; Vankudothu, S. & et al Plant diseases and pernicious insects are a considerable threat in the agriculture sector. Therefore, early detection and diagnosis of these diseases are essential. The ongoing development of profound deep learning methods has greatly helped in the detection of plant diseases, granting a igorous tool with exceptionally precise outcomes but the accuracy of deep learning models depends on the volume and the quality of labeled data for training. In this paper, we have proposed a deep learning-based method for tomato disease detection that utilizes the Conditional Generative Adversarial Network (C-GAN) to generate synthetic images of tomato plant leaves. Thereafter, a DenseNet121 model is trained on synthetic and real images using transfer learning to classify the tomato leaves images into ten categories of diseases. The proposed model has been trained and tested extensively on publicly available Plant Village dataset.

CHAPTER 3

PROJECT OVERVIEW

3.6 OBJECTIVES

These applications play a vital role in recognition the crop's leaves image and finding out the disease cause and fertilize suggestions after comparing with the trained model using Convolutional Neural Network helps to differentiate each image by converting them by process of matrix convolution. CNN represents an interesting method for adaptive image processing and forms a link between general feed-forward an interesting method for adaptive image processing and forms a link between general feed-forward networks and adaptive filters. Any user who grows different crops may not know all the diseases caused by fungus and bacteria. By uploading, their affected crops leave users to benefit by understanding the disease name and cause then our client can suggest fertilizer by analyzing the composition between modeled images and user images. application creates a good environment for fertilizer suggestions and two more important processes where the user can have weather and soil reports. Based on the location given by the user, a weather report is generated and a soil report contains the suggested crops to grow by the user based on the soil samples given by the user. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. Plant is exposed to many attacks from various micro-organism, bacterial disease and pests. The symptoms of the attacks are usually distinguished through the leaves, stem or fruit inspection. Disease that are commonly attack plants are Powdery Mildew and Leaf Blight and it may cause severe damaged if not controlled in early stages. The method is going to used in this project has widely being used for identification, detection, grading and quality inspection in the agriculture field. Detection and identification disease of a plant is very important especially, n producing an affected leaf.

3.7 MOTIVATION

Plant diseases a very devastating threat to the agriculture industry and have the potential of pushing the whole of human society into starvation if not detected early. With the implementation of Convolutional Neural Network models, the detection of plant diseases will become easier and cheaper helping many farmers in the timely detection of plant diseases, preventing wastage of plants and protecting the transmission of diseases from diseased to healthy plants. A lot of the research that has been carried out on plant disease present a comparative study using different CNN models but fail to explain the predictions made by their models.

In this project we not only provide a comparative study between the workings of a simple and complex model, but we also aim at providing explainability for the predictions made by the models. The motivation for including explainability lies in the fact that most of the CNN models widely used in this project for detecting the diseases of the leaf, which leads to the users using this model for predicting in not trusting and understanding how this CNN models works and make their predictions. The Artificial Intelligence techniques allows the users to understand their model predictions better and make decisions on their own as to weather, trust their model or not. The use of

- TensorFlow
- BS4
- Pillow
- Django
- PIP

this server helps a great deal in the applications of plants disease detection as the transparency and explainability of the modes being is vital in gaining the trust of the workers working in the agriculture industry as their livelihood is dependent on their production of healthy plants.

3.7.1 REQUIREMENTS

SOFTWARE REQUIREMENTS:

- PYCHARM IDE
- PYTHON
- MYSQL DATABASE
- SERVER: TENSORFLOW, MYSQL CLIENT, BS4, PILLOW, DJANGO, PIP.

In this project we are going to make a **CONSOLIDATED SYSTEM Application Using Convolutional**

Neural Network for finding the diseases of the plants and the perfect place of soil where plants can grow without any diseases.

3.8 EXISTING SYSTEM

In general, critical factors for image analysis and pattern recognition, there are many models to initialize the process. To learn a robust distance metric, we need abundant side information which is usually unavailable in practice due to the high labeling cost.

A process like a matrix factorization, distance metric learning, and Clustering method finds similar pixels to classify into clusters or classes, yet these distance metric learning problems in unsupervised or weakly supervised clustering tasks, especially for the unified theoretic schemes and optimization algorithms. There is no proper image recognition using a huge number of images trained into a model which can be achieved by a Convolution neural network. Basically, in the existing system there is no such feature by which we can detect the affected leaf, for which there is a huge cause of damage of different types of crops and plants. In recent times due to bad weather and less information about soil farmers facing huge losses. In crops different types of substances are present like diseases, pests, etcThe impact of these dangerous factors on crops has an appearance, morphology, and other characteristics of the leaves. By using the existing system it is impossible to find an affected leaf and cure it.

3.9 PROPOSED SYSTEM

In the proposed system, any farmers who want to find the cause and disease formed in their crops are benefited. When the former upload leaves images of the affected crop by fungus and bacteria, the user cannot conclude what caused it and what fertilizer should be used to mitigate the problem in near future. Admin has a trained model which contains a huge amount of images by matrix conversion using CNN then admin compares the user given images with the trained model. So, initial images are converted into an input layer which is a grayscale image.

The output layer is a binary or multi-class label. Hidden layers consist of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network. The above process takes care of image conversion 4*4 matrix to segregate each block according to the density of greyscale, compare it with the same kind of format and recognize disease using the trained model. Then the client suggests fertilizer required for the crop which is beneficial for any farmers. Our application also suggests which crop to grow according to soil input given by farmers, then the user can have weather reports according to the location they are given. These are achieved by web scraping and beautiful soup.

➢ FEATURES

- Disease Detection.
- Image Recognition using CNN.
- ReLu (Rectifier Linear Unit).
- Fertilizer Suggestion.
- Soil suggestion for crop to grow.
- Weather report according to the location provide by the user.
- Web Scraping.
- Beautiful Soup Python package.

3.10 TYPES OF DISEASE LEAF USED

Apple Leaf

Corn Leaf

Potato Leaf

Tomato Leaf

Fig: Types of leaf diseases

CHAPTER 4

METHODOLOGY

4.1 OVERALL ARCHITECTURES

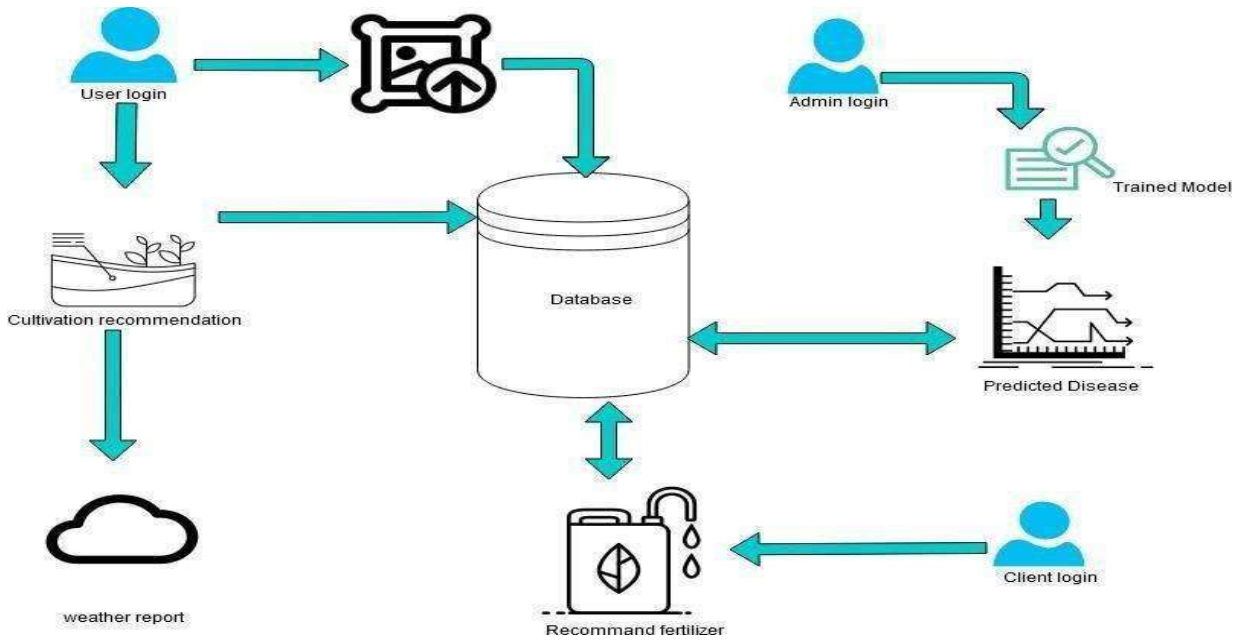


Fig: ARCHITECTURE DIAGRAM

This diagram is the architecture of this project. Mainly users should login to upload the affected image of the leaf which is already uploaded in the MySQL Database. Then admin should login to predict disease of the image which will work through trained models and this trained model built by convolutional neural network algorithm which is basically a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data. After detecting the diseases of the leaf, the user should check with recommendation of cultivation and weather report which is most important for finding the place where crops can grow. Then for better fertilizer clients should login and search for required fertilizer for crops and plant leaves.

4.1.1 PLANT DEPLOYMENT

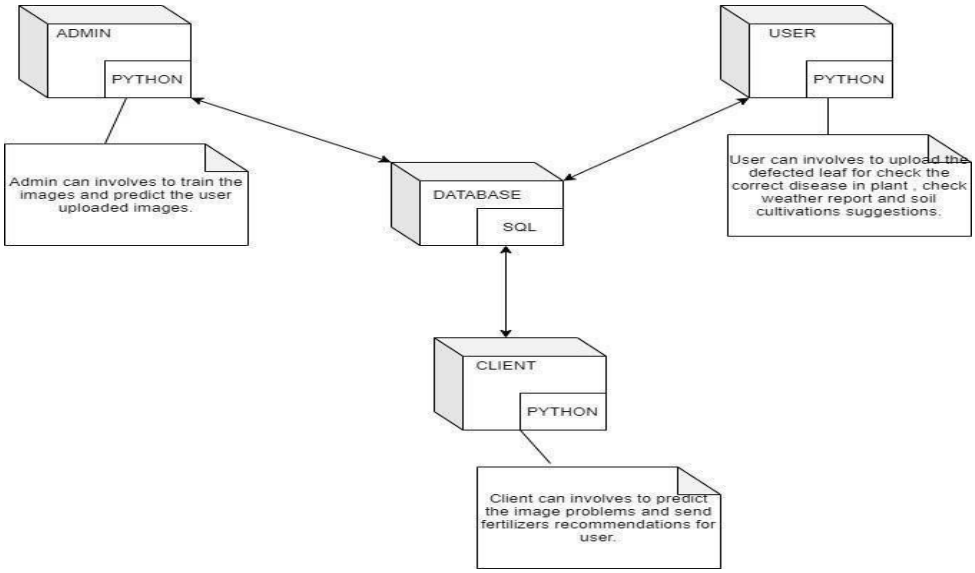
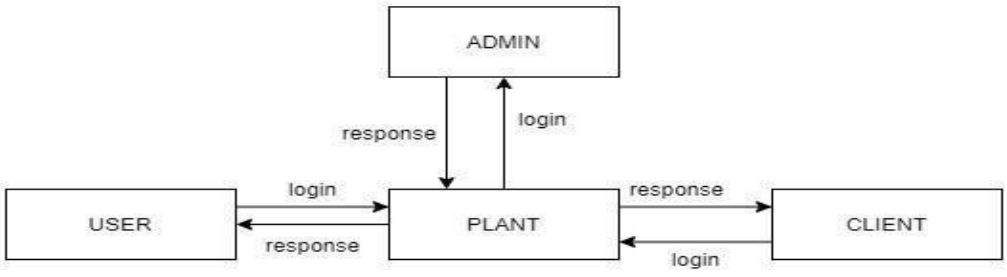


Fig: PLANT DEPLOYMENT

In this plant collaboration diagram where admin involves to train the images and predict what defected leaf image by the user which will be stored in MySQL database, in other hand user can also upload the defected leaf for checking the correct diseases present in the plant and for finding the better place to grow where there will be no defected leaf user can check weather report and soil cultivations suggestions. User request accomplished by a client who can check what's the problem in the image and which is most important for agriculture is fertilizers. The client can help users with fertilizer recommendations.

4.1.2 DATA FLOW DIAGRAM (DFD)

LEVEL 1



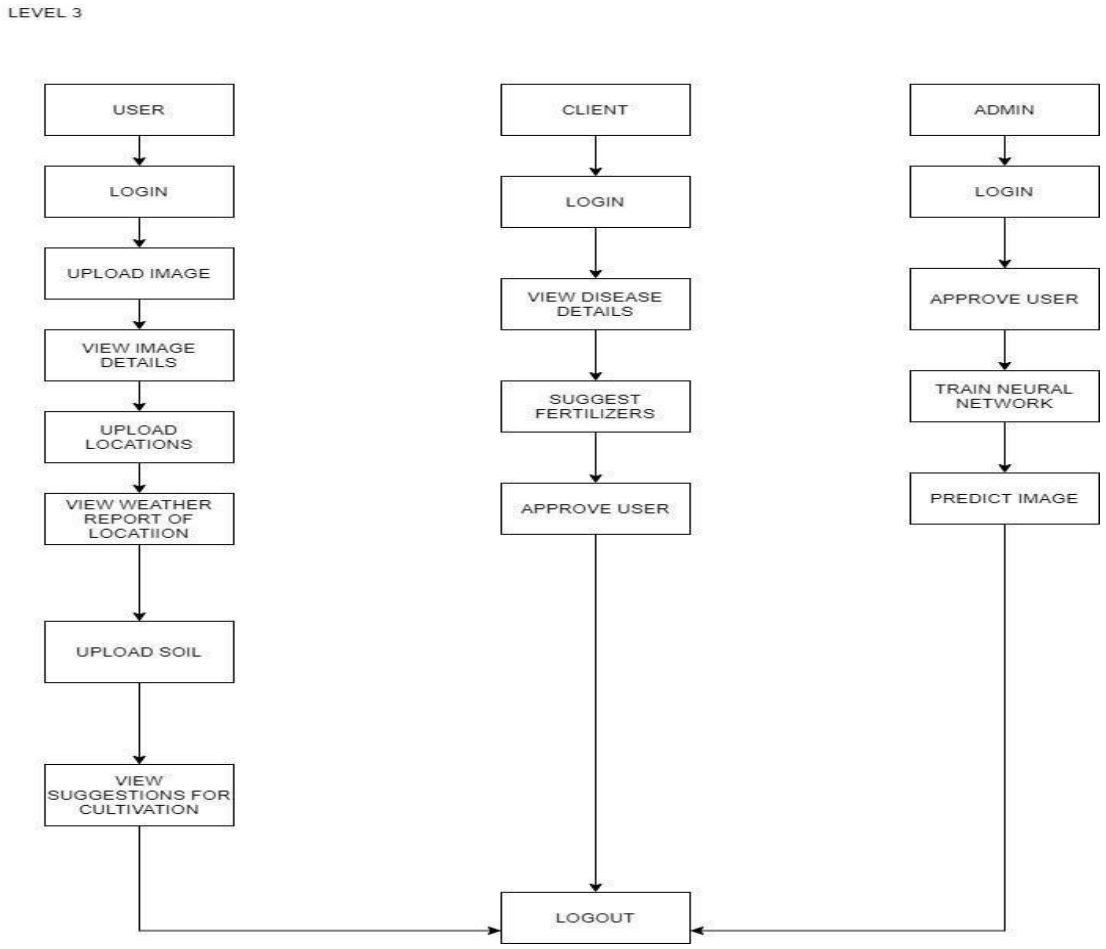


Fig: DATA FLOW DIAGRAM

4.1.3 PLANT ENTITY RELATIONSHIP DIAGRAM

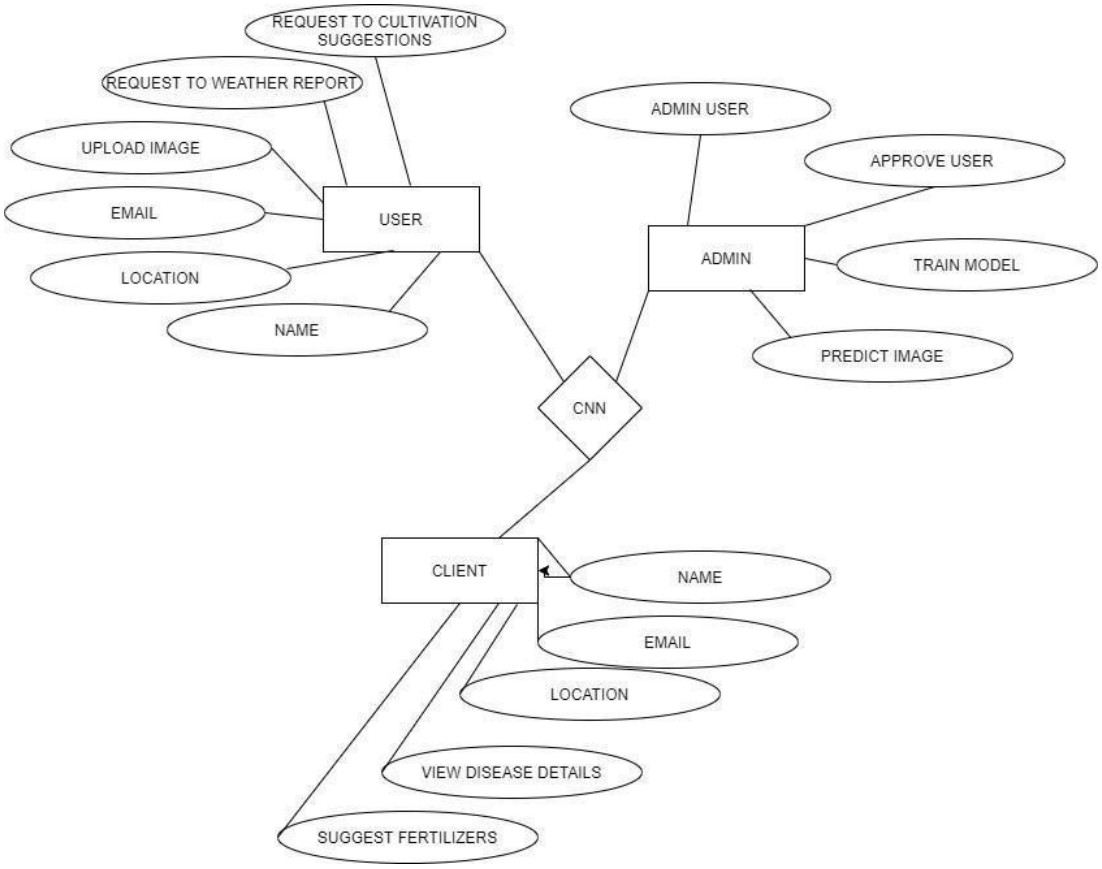


Fig: ENTITY RELATIONSHIP DIAGRAM

4.1.4 PLANT USE CASE DIAGRAM

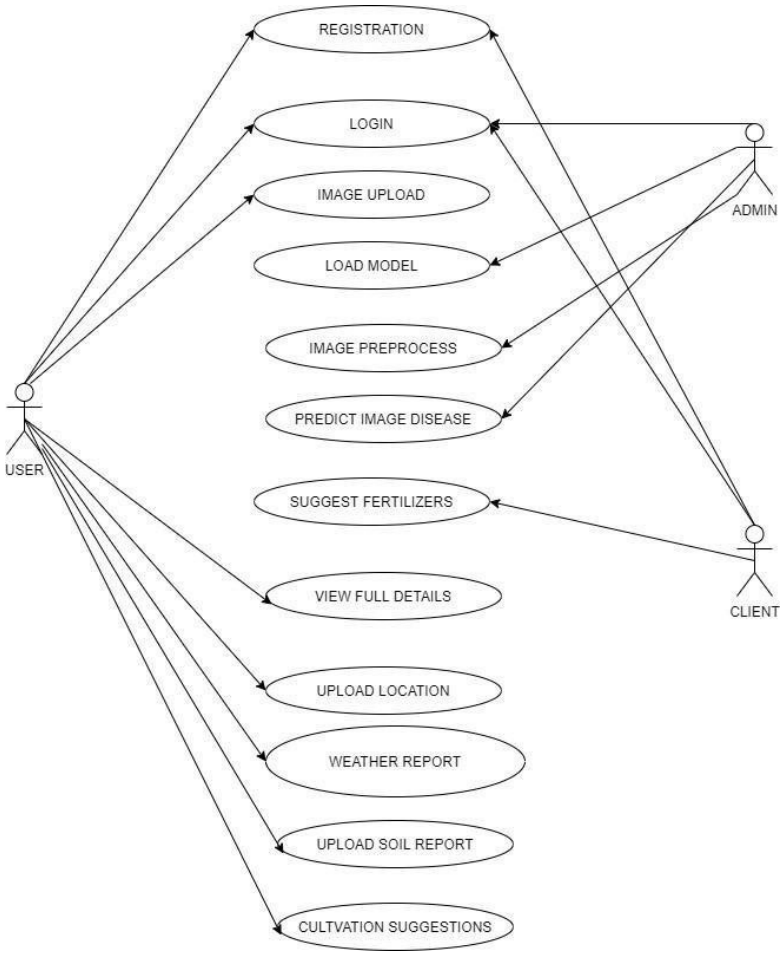


Fig: USE CASE DIAGRAM

4.1.5 WORKING

The app uses a pre-trained CNN model to identify crop diseases from images and recommends fertilizers based on the disease. It also provides weather reports and suggests crops based on user-submitted soil samples.

4.2 LANGUAGE DESCRIPTION

4.2.1 PYTHON PROGRAMMING

Python is an interpreted language and not a compiled one, although compilation is a step. Python code, written in **.py** file is first compiled to what is called byte code which is stored with a **.pyc or .pyo** format. Instead of translating source code to machine code like C++, Python code it translated to byte code. This byte code is a low-level set of instructions that can be executed by an interpreter. One popular advantage of interpreted languages is that they are platform-independent.

As long as the Python byte code and the Virtual Machine have the same version, Python byte code can be executed on any platform (Windows, macOS, etc). Dynamic typing is another advantage. In static-typed languages like C++, you have to declare the variable type and any discrepancy like adding a string and an integer is checked during compile time. In older programming languages, memory allocation was quite manual. Many times when you use variables that are no longer in use or referenced anywhere else in the program, they need to be cleaned from the memory. Garbage Collector does that for you.

➢ HOW PYTHON INTERPRETER WORKS

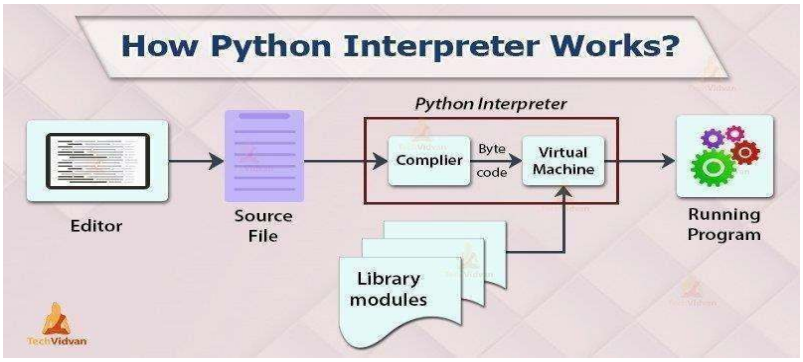


Fig: HOW PYTHON INTERPRETER WORKS

Python interpreter is **responsible for executing the Python scripts**. Python interpreter is a piece of software which works between the Python program and computer hardware. Here we are describing the series of ways to run Python scripts. The operating system command- line or terminal.

We write the python code in any text editor and save the same file using the ".py" extension in our system. Now, how will this code run? There must be some application or program like "python" or "python3" that must be installed in your system, and this is their duty to run this python code. This type of program is called Interpreter. Python does provide a python shell, which is used to execute a single command in python and display the result accordingly. The interpreter's line-editing features include interactive editing, history substitution and code completion on systems that support the GNU Readline library. Perhaps the quickest check to see whether command line editing is supported is typing Control-P to the first Python prompt you get. If it beeps, you have command line editing; see Appendix Interactive Input Editing and History Substitution for an introduction to the keys. If nothing appears to happen, or if

^P is echoed, command line editing isn't available; you'll only be able to use backspace to remove characters from the current line.

4.2.2 CHARACTERISTICS OF PYTHON

We briefly list some of C's characteristics that define the language and also have led to its popularity as a programming language. Naturally we will be studying many of these aspects throughout the course.

Python is a dynamic, high level, free open source and interpreted programming language. It supports object-oriented programming as well as procedural oriented programming.

In Python, we don't need to declare the type of variable because it is a dynamically typed language.

Characteristics of Python:

- There are many features in Python, some of which are discussed below –

- Python is a high-level programming language. Python is very easy to learn the language as compared to other languages like C, C#, JavaScript, Java, etc...

- One of the key features of python is Object-Oriented programming. Python supports object- oriented language and concepts of classes, objects encapsulation, etc.

- Python is a high-level language. When we write programs in python, we do not need to remember the system architecture, nor do we need to manage the memory.

- Python is an **Extensible** language. We can write some Python code into C or C++ language and also, we can compile that code in C/C++ language.

- Python language is also a portable language. For example, if we have python code for windows and if we want to run this code on other platforms such as Linux, Unix, and Mac then we do not need to change it, we can run this code on any platform.
- Python is also an integrated language because we can easily integrate python with other languages like c, c++, etc.

- Python is an Interpreted Language because Python code is executed line by line at a time. unlike other languages C, C++, Java, etc. there is no need to compile python code; this makes it easier to debug our code. The source code of python is converted into an immediate form called **bytecode**.

4.3 MYSQL DATABASE

MySQL is a widely used open-source database management system.It's known for being fast, easy to use, and able to handle large amounts of data (scalable).Commonly used for web applications, and supported by Oracle.

MySQL is a Relational Database Management System (RDBMS) software that provides many things, which are as follows:

- It allows us to implement database operations on tables, rows, columns, and indexes.
- It defines the database relationship in the form of tables (collection of rows and columns), also known as relations.
- It provides the Referential Integrity between rows or columns of various tables. It allows us to update the table indexes automatically.
- It uses many SQL queries and combines useful information from multiple tables for the end- users. It is very important to understand the database before learning MySQL. A database is an application that stores the organized collection of records. It can be accessed and managed by the user very easily. It allows us to organize data into tables, rows, columns, and indexes to find the relevant information very quickly.

4.4 WORKING OF MYSQL

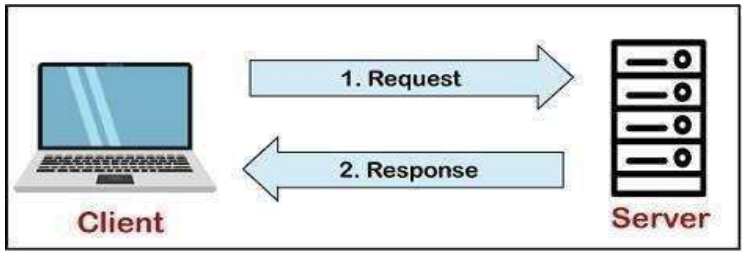


Fig: WORKING OF MYSQL

MySQL follows the working of Client-Server Architecture. This model is designed for the end-users called clients to access the resources from a central computer known as a server using network services. Here, the clients make requests through a graphical user interface (GUI), and the server will give the desired output as soon as the instructions are matched. The process of MySQL environment is the same as the client- server model.

The core of the MySQL database is the MySQL Server. This server is available as a separate program and responsible for handling all the database instructions, statements, or commands. The working of MySQL database with MySQL Server are as follows:

- MySQL creates a database that allows you to build many tables to store and manipulate data and defining the relationship between each table.
- Clients make requests through the GUI screen or command prompt by using specific SQL expressions on MySQL.
- Finally, the server application will respond with the requested expressions and produce the desired result on the client-side.

4.5 CHARACTERISTICS OF MYSQL

MySQL is a system that helps store and manage data efficiently. Databases generally store data in a structured fashion. It is written in C and C++, and it has been tested with a variety of compilers to check for bugs and inconsistencies.

Let us understand some of the main features associated with MySQL:

- MySQL is open-source, which means this software can be downloaded, used and modified by anyone. It is free-to-use and easy-to-understand. The source code of MySQL can be studied, and changed based on the requirements.

- It uses GPL, i.e. GNU General Public license which defines rules and regulations regarding what can and can't be done using the application. MySQL stores data efficiently in the memory ensuring that data is consistent, and not redundant.

- Hence, data access and manipulation using MySQL is quick.Scalability refers to the ability of systems to work easily with small amounts of data, large amounts of data, clusters of machines, and so on. MySQL server was developed to work with large databases.

- It contains multiple data types such as unsigned integers, signed integers, float (FLOAT), double (DOUBLE), character (CHAR), variable character (VARCHAR), text, blob, date, time, datetime, timestamp, year, and so on.

- It supports different character sets, and this includes latin1 (cp1252 character encoding), German, Ujis, other Unicode character sets and so on.

4.6 ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is essentially the attempt to make machines mimic human intelligence. This involves machines learning from data, identifying patterns, and using that knowledge to solve problems or make decisions. Unlike traditional programming, AI allows machines to learn and adapt without being explicitly coded for every situation.

While AI has made significant progress, it still can't fully replicate human capabilities. Current AI systems excel at specific tasks but lack the general intelligence and flexibility of humans.

4.6.1 COMPONENTS OF ARTIFICIAL INTELLIGENCE

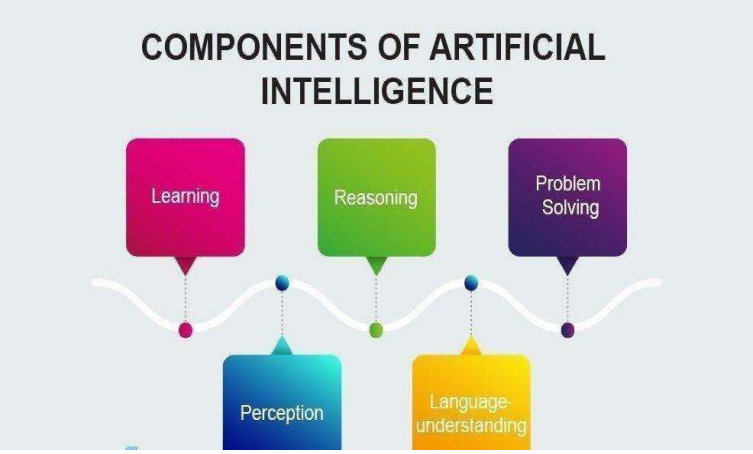


Fig: COMPONENTS OF ARTIFICIAL INTELLIGENCE

- **Learning**

Similar to humans, computer programs also learn in different manners. Talking of AI, learning by this platform is further segregated into a varied number of forms. One of the essential **components of AI,** learning for AI includes the trial-and- error method. The solution keeps on solving problems until it comes across the right results.

This way, the program keeps a note of all the moves that gave positive results and stores it in its database to use the next time the computer is given the same problem. The learning component of AI includes memorizing individual items like different solutions to problems, vocabulary, foreign languages, etc., also known as rote

learning. This learning method is later implemented using the generalization method.

- **Perception**

In using the 'perception' component of Artificial Intelligence, the element scans any given environment by using different sense-organs, either artificial or real. Further, the processes are maintained internally and allow the perceiver to analyze other scenes in suggested objects and understand their relationship and features. This analysis is often complicated as one, and similar items might pose considerable amounts of different appearances over different occasions, depending on the view of the suggested angle. At its current state, perception is one of those **components of artificial intelligence** that can propel self-driving cars at moderate speeds. FREDDY was one of the robots at its earliest stage to use perception to recognize different objects and assemble different artifacts.

- **Language Understanding**

Language Understanding in AI: AI is being developed to understand human language, like English. This allows for natural communication with machines and simplifies giving instructions to robots or intelligent systems.

Natural Language Processing (NLP): This is a specific type of AI technique that focuses on how computers can work with and understand human languages. NLP is used in various applications, such as voice assistants and machine translation

CHAPTER 5

RESULTS AND DISCUSSIONS

1. SCREENSHOT

Fig: Welcome Screen

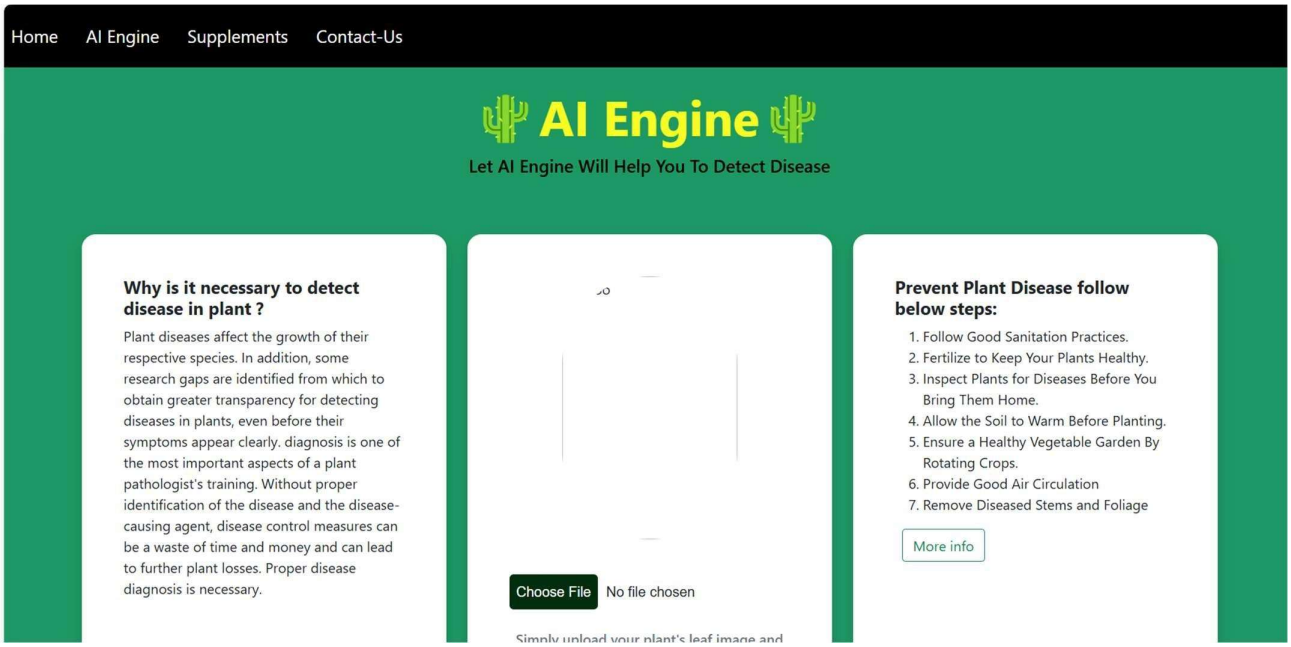
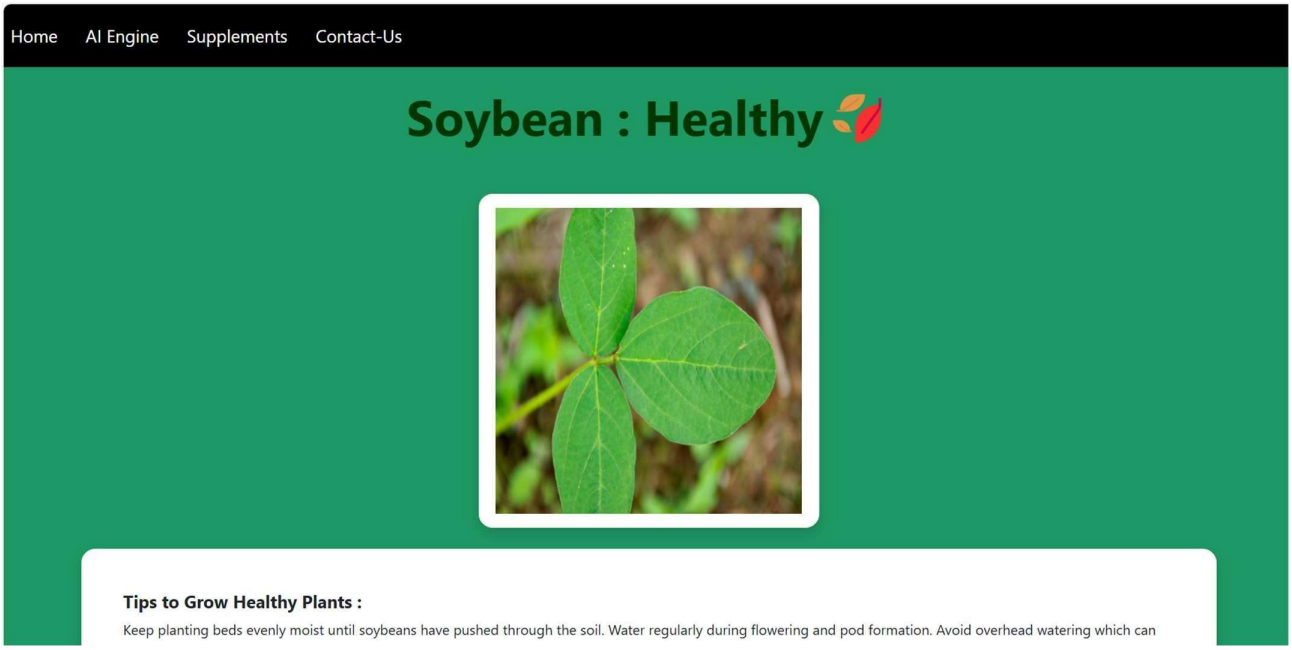


Fig: Uploading Image and Soil report check

2. OUTPUT SCREEN



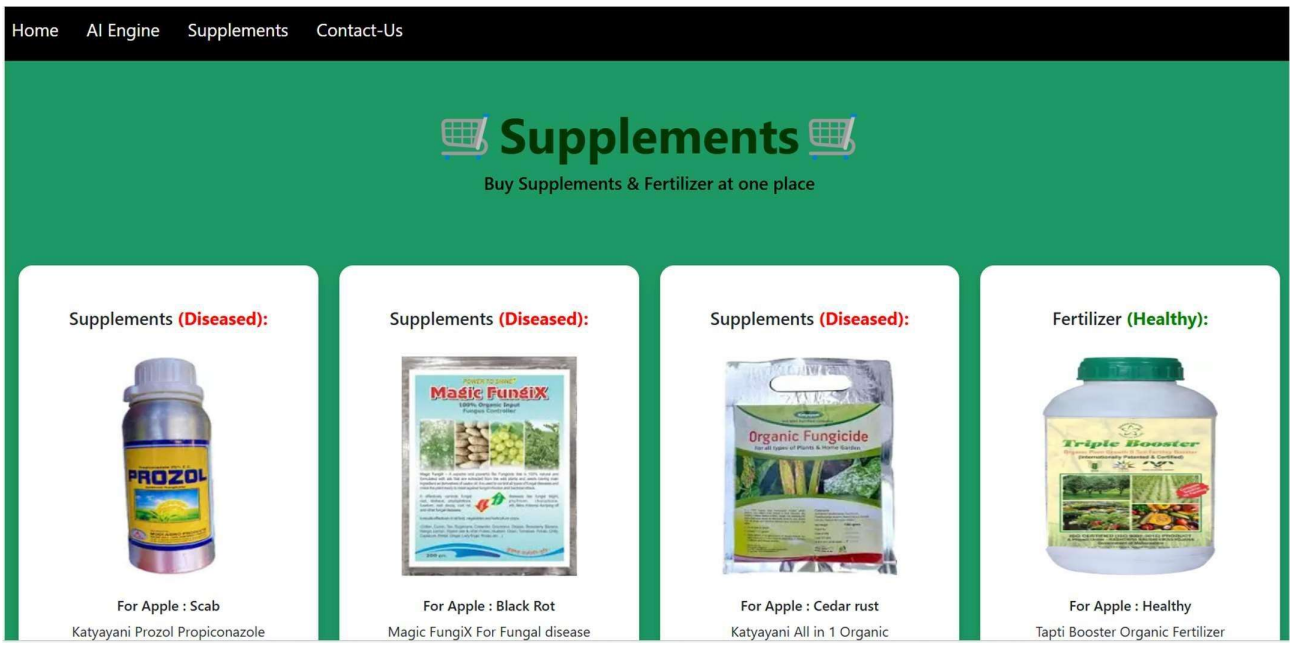


Fig: Output Screen

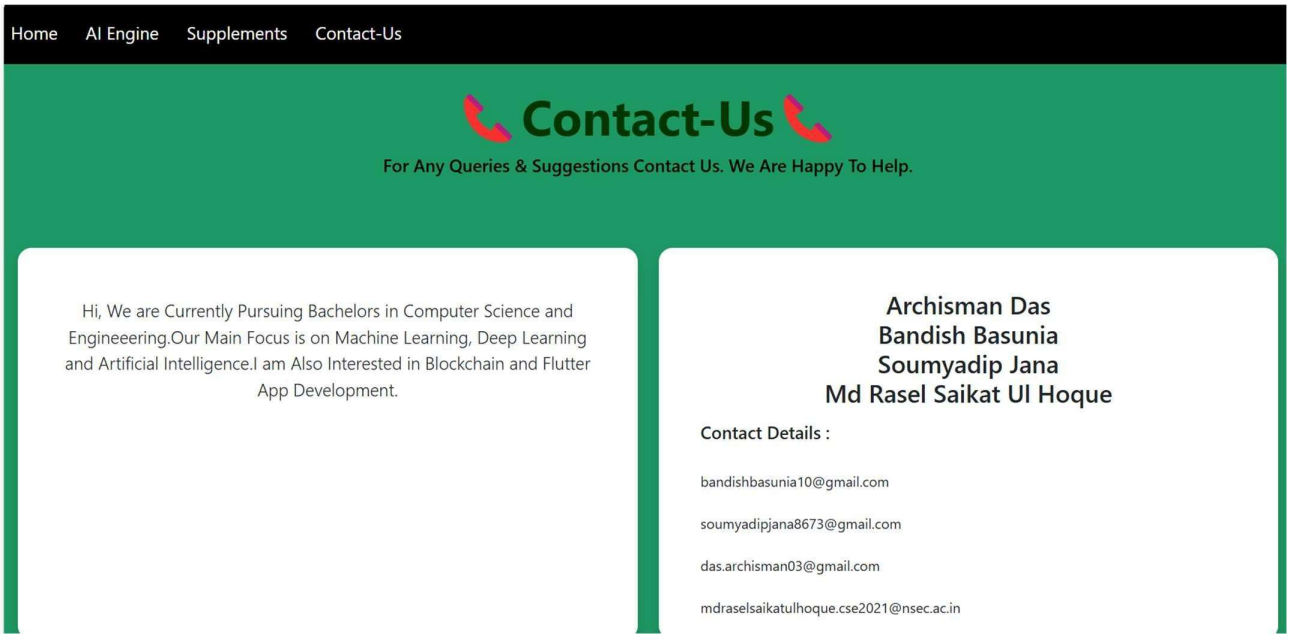


Fig: Developers' Details

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 CONCLUSION

In this paper, we present Image recognition using a convolution neural network where the user's uploaded leaves are matched with trained data using CNN, where pre- processing is much lesser compared to other processes like Distance metric learning and matrix factorization. Even though CNN has high accuracy in image recognition problems, CNN does not encode the position and orientation of the object. Lack of ability to be spatially invariant to the input data and lots of training data is required. We leave these constraints for future enhancement where the application should encode the position and or orientation of the object and work efficiently with minimal trained data.

6.2 FUTURE WORK

Our application plays a vital role in recognizing the crop's leaves image and finding out the disease cause and fertilize suggestions after comparing with the trained model using Convolution Neural Network helps to differentiate each image by converting them by process of matrix convolution. CNN represents an interesting method for adaptive image processing and forms a link between general feed-forward neural networks and adaptive filters. Any user who grows different crops may not know all the diseases caused by fungus and bacteria.

By uploading, their affected crops leave users to benefit by understanding the disease name and cause then our client can suggest fertilizer by analyzing the composition between modeled images and user images. Our application creates a good environment for fertilizer suggestions and two more important processes where the user can have weather and soil reports. Based on the location given by the user, a weather report is generated and a soil report contains the suggested crops to grow by the user based on the soil samples given by the user. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms.

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