Project report on

TOMATO DISEASE PREDICTION

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the academic requirements for the award of the degree.

Bachelor of Technology

In

Computer Science and Engineering

Submitted by

B. Deepak	**19H51A05C5**
CH. Karthik	**19H51A05C8**
M. Sai Neeraj	**19H51A05D9**

Under the esteemed guidance of

Mr.Abdul Rahman

(Assistant Professor)

EXPLORE TO INVENT

Department of Computer Science and Engineering

CMR COLLEGE OF ENGINEERING AND TECHNOLOGY

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KANDLAKOYA, MEDCHAL ROAD, HYDERABAD - 501401.

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY

KANDLAKOYA, MEDCHAL ROAD, HYDERABAD – 501401

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Project report entitled **"TOMATO DISEASE PREDICTION"** being submitted by **B.DEEPAK (19H51A05C5), M.SAI NEERAJ (19H51A05D9), CH.KARTHIK(19H51A05C8)** in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodies in this project report have not been submitted any other University or Institute for the award of any degree.

Mr.Abdul Rahman	**Dr. S. Siva Skandha**
Assistant Professor	**Associate Professor and HOD**
Dept. of CSE	**Dept. of CSE**

Acknowledgment

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B.DEEPAK 19H51A05C5
M.SAI NEERAJ 19H51A05D9
CH.KARTHIK 19H51A05C8

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ABSTRACT

A country's inventive growth is dependent on the agricultural sector.Agriculture, the foundation of all nations, offers food and raw resources. Agriculture is hugely important to humans as a food source. As a result, plant diseases detection has become a major concern. Traditional methods for identifying plant disease are available. However, agriculture professionals or plant pathologists have traditionally employed empty eye inspection to detect leaf disease. This approach of detecting plant leaf disease traditionally can be subjective, time-consuming, as well as expensive, and requires a lot of people and a lot of information about plant diseases. It is also possible to detect plant leaf diseases using an experimentally evaluated software solution. Currently, machine learning and deep learning are using in recent years. The agriculture sector is also not a exception for machine learning. In this paper, we applied "Convnets" for plant disease detection and classification. We collected a PlantViallge dataset from Kaggle. It contains images of 15 different classes of plant leaves. We achieved an accuracy of 98.3% for tomato plant disease detection. Experimental results have shown that our model achieved a good accuracy rate for plant leaf disease detection and classification. Using that model we implement website using the reactjs for hands on use for the farmers.

CHAPTER 1
INTRODUCTION

1.1 Motivation of Study

Plant diseases possess 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 machine learning models in the domain of plant pathology, 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 detection present a comparative study using different machine learning models but fail to explain the predictions made by their models. In this research 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 machine learning models widely used in this domain are black-box models, which leads to the users using these models for prediction in not trusting and understanding how their models make their predictions. The application of Explainable Artificial Intelligence techniques demystifies these black-box models and allows the users to understand their model predictions better and make decisions on their own as to whether, trust their model or not. The use of XAI helps a great deal in the application of plant disease detection as the transparency and explainability of the models being used 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.

1.2 Overview

The aim of this thesis is to implement two different machine learning models, namely, Convolutional neural network (CNN) on the plant village dataset and also evaluate the aforementioned models based on the following evaluation metrics: Accuracy, Precision, Recall and F1-Score. The study focuses on the disease identification of tomato leaves from the plant village dataset in specific (J and Gopal, 2019). The novelty of this study lies in the fact that this study also aims at providing transparency and explainability for the decisions made by the aforementioned models using the Local interpretable model-agnostic explanations (LIME). The use of XAI in order to explain the predictions made by the machine learning models is very rare and not to be found in many of the research papers in this particular domain.

CHAPTER 2

BACKGROUND WORK

2.1 Artificial Neural Networks

Artificial Neural Networks, abbreviated as ANNs can be described as computational systems that are designed to replicate the human brain's analysis and information processing skills, and just like the human brain an ANN consists of a directed graph with interconnected processing elements known as neurons (Jain, Mao and Mohiuddin, 1996). There are different types of neural networks such as the Recurrent Neural Network (RNN), Multilayer Perceptron (MLP), Convolutional Neural Network (CNN), etc. Among the many Neural Networks present the most common one is the Multilayer Perceptron network (MLP). A typical MLP network comprises of different node layers, namely, an input layer, one or more hidden layers and finally an output layer. All of the nodes are connected to each other and each node is associated with a weight and threshold. The weight refers to the importance that two nodes connecting have in a network and data is transferred from one layer to another only if the output of an individual node is above the threshold specified (Jain, Mao and Mohiuddin, 1996). An ANN's training process involves recognizing patterns in the data that is fed into the network, during this supervised learning phase the actual and the desired output of the ANN are compared (Cost function) and the training process is presented a number of times (epochs) until there is little or no difference between the actual and desired output. The Cost function is minimized using a 7 process known as backpropagation, wherein the network works backwards from the output layer to the input layer adjusting the weights of its nodes until the error produced between the actual and desired output is the lowest possible .

A simple Convolutional Neural Network's architecture consists of three main layers, namely, Convolutional layer, Pooling layer and the Fully connected layer. The Convolutional layer is regarded as the main building block of a CNN, it consists of learnable parameters known as filters/kernels. The filter is responsible for finding patterns (textures, edges, shapes, objects, etc) in the input image. Each filter slides/convolves over the height and width of the input image, computing the dot product between the filter and the pixels present in the input image. The resultant of a Convolutional layer is a feature map that summarizes all the features found in the input .

CHAPTER 3
PROPOSED SYSTEM

3.1 Proposed model

- In the proposed system we make a website where farmers can upload the image of the leaf
- Try to make the farmers happy without anynoncence
- We will provide clean user interface

3.2 Hardware Requirements :

- Processor : I9 and above
- RAM: 16 GB
- Input devices : mouse , keyboard
- Hard disk:20 GB
- Speed:1.2GB

3.3 Software Requirements :

- Front End: HTML5, CSS3, Javascript.
- Back End: PHP, MYSQL
- Web Server: XAMPP

3.4 System Overview :

Traditional machine vision methods have poor robustness in complex scenes, so it is difficult to meet the work requirements in complex scenes. The performance of CNN in image recognition has made great progress in the past few years, and in the ImageNet Large Scale Visual Recognition Challenge (ILSVRC), a lot of deep learning architectures have emerged, such as AlexNet (Krizhenvshky et al., 2012), GoogleLeNet (Szegedy et al., 2015), VGGNet (Simonyan and Zisserman, 2014), ResNet (Xie et al., 2017), and the accuracy of general image recognition is constantly being refreshed. CNN's hard work and great breakthrough in the large-scale image classification competition prompted people to consider applying it to the problem of object detection. Different from image classification, object detection needs to detect and locate speci 2.1 Artificial Neural Networksfic multiple objects from the image, which is mainly divided into two categories. One is to generate a series of candidate frames as samples by the algorithm, and then classify the samples by CNN, such as RCNN (Girshick et al., 2014), faster RCNN (Ren et al., 2016), and R-FCN (Dai et al., 2016). The other one directly transforms the problem of object bounding box location into regression problem, which does not need to generate candidate boxes. The landmark algorithms include SSD (Liu et al., 2016) and YOLO.

CNN:

Arsenovic et al. (2019) established a plant disease dataset with 79,265 pieces collected under different meteorological conditions. A two-level structure, PlantDiseasenet, which is trained by PDNet-1 and PDNet-2 at the same time, is proposed. PDNet-1 uses the detection method proposed in the Yolo algorithm as the detection tool of plant leaves, and PDNet-2 is responsible for the classification of plant leaves. After training, the accuracy of the model is 93.67%. Jiang et al. (2019) proposed an improved CNN-based deep learning method for real-time detection of apple leaf diseases and insect pests. Firstly, through data expansion and image annotation technology, an apple leaf disease dataset (ALDD) composed of laboratory images and complex images under real field conditions is constructed. On this basis, a new method is proposed by introducing GoogleNet inception structure and rainbow concatenation. Finally, the proposed INAR-SSD (SSD with perception module and rainbow condition) model was trained to detect the five common apple leaf diseases and insect pests. The experimental results show that the model achieved 78.80% mAP and the detection speed is as high as 23.13 FPS. Tian et al. (2019) proposed a method of Apple Anthracnose damage detection based on deep learning and optimized the feature layer of Yolo V3 model with low resolution by using Densenet, which has greatly improved the utilization of neural network features and improved the detection results of Yolo V3 model. The experimental results show that the model achieved 95.57% mAP. Zheng et al. (2019) established a CropDeep species classification and detection dataset, including 31,147 images and more than 49,000 annotation examples from 31 different categories. These images are collected in real natural environment with different cameras, and the most advanced deep learning classification and detection model is used to provide a wide range of baseline experiments. The results show that the existing classification method based on deep learning can achieve more than 99% in classification accuracy, and only 92% in object detection accuracy. Meanwhile, Yolo V3 model has good application potential in agricultural detection tasks to cart. When user want to checkout he can click the view cart option where he will be redirected to the Cart Page. In the Cart he can confirm his order by checking the order details and can also update the cart by removing the items he doesn't want. After checking all the details, he can proceed to checkout where his order will be confirmed and message will be send to the registered mobile number along with email on the registered email-id. The payment will be cash on delivery once user will logout he will be redirected to home page and will be in guest mode admin module: If the admin has already register he can sign in directly by entering his registered email id and password; if not then he will be redirected to the register page from where he can register himself and view all the order details. Once the admin has login in to the system he can view various options like add item, view item, update item, confirm order, view order status, etc.

When the user enters in the add Item page he can add items by entering the item type i.e. whether it veg, non veg, etc. and item’s name and price. Then in the view item page the admin can see all the item list along with their details i.e. price, name, where he can update the price of the items or delete or add new items in the list. And in the view order page he can view all the orders that has been placed by the customer, in this page the admin will be able to see the order details like at what time the order was placed, and when is the delivery date, along with that the admin can view the order status in which he can make a glance of which orders are pending to be delivered. When the admin has finished by checking all the orders or updating items he can logout out of the system by clicking on logout button. We have also made About us page where the guest can read about the Company’s policy or details like address, phone number, email-id, etc. There is a Contact us page (feedback page) where the user can complaint.

3.5 System Modules:

User

- Register and login
- Upload Photo
- Result

Upload photo details:

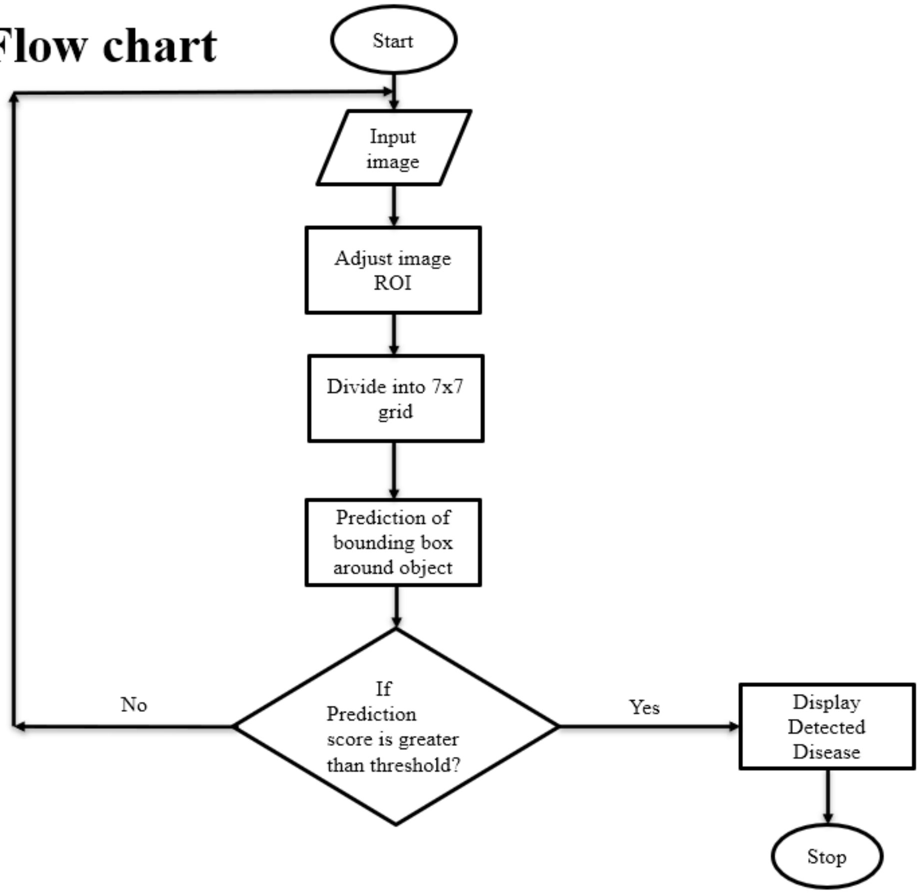
Farmers need upload photo of the tomato leaf

Result:

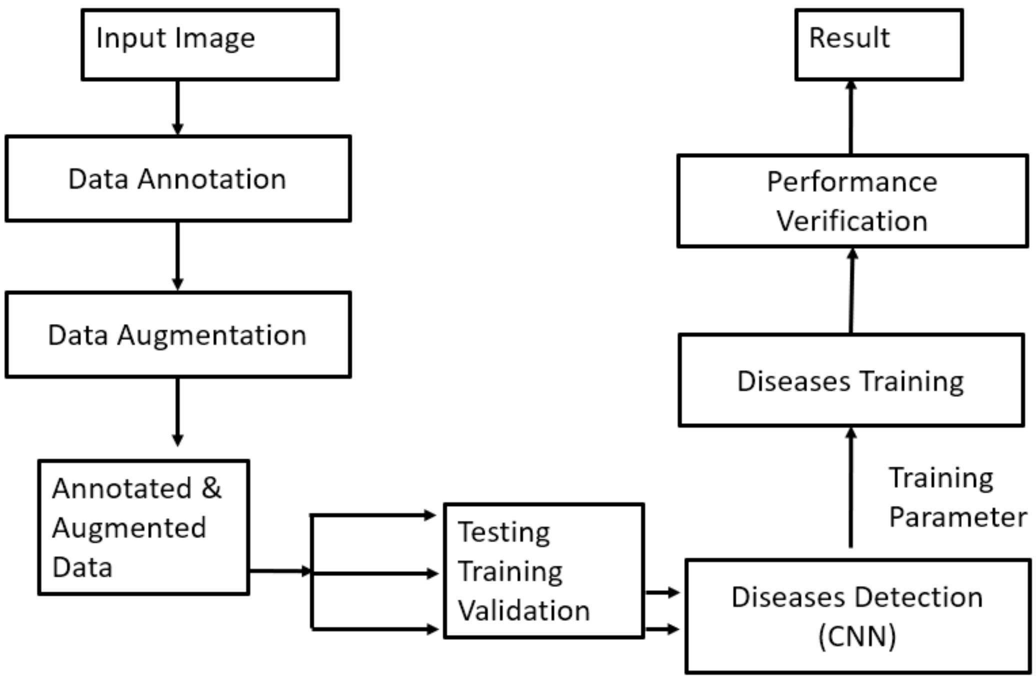
Result of the prediction will be appear on the screen

CHAPTER 4
DESIGNING

4.1 Flow chart



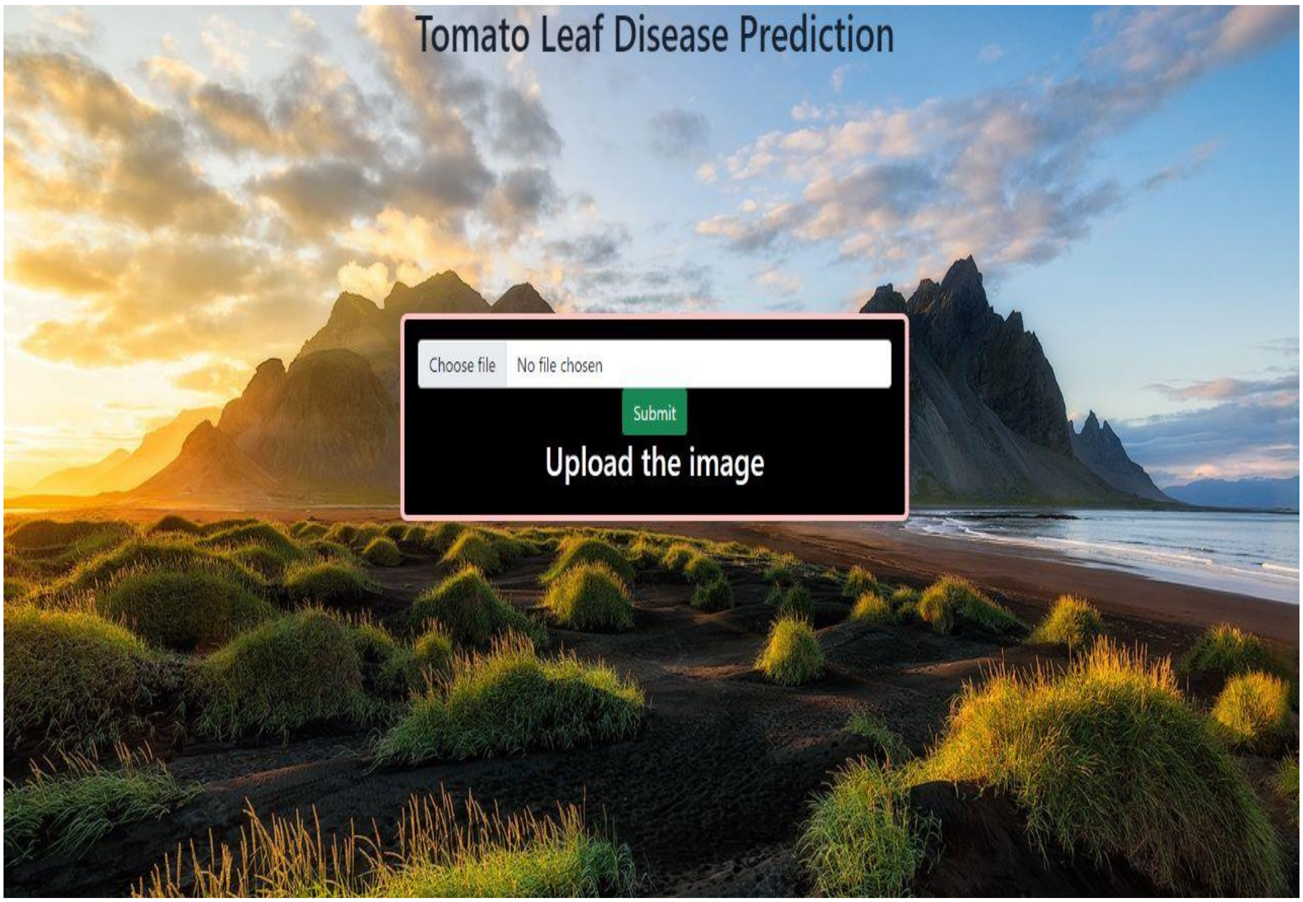
4.2 Block Diagram of the system



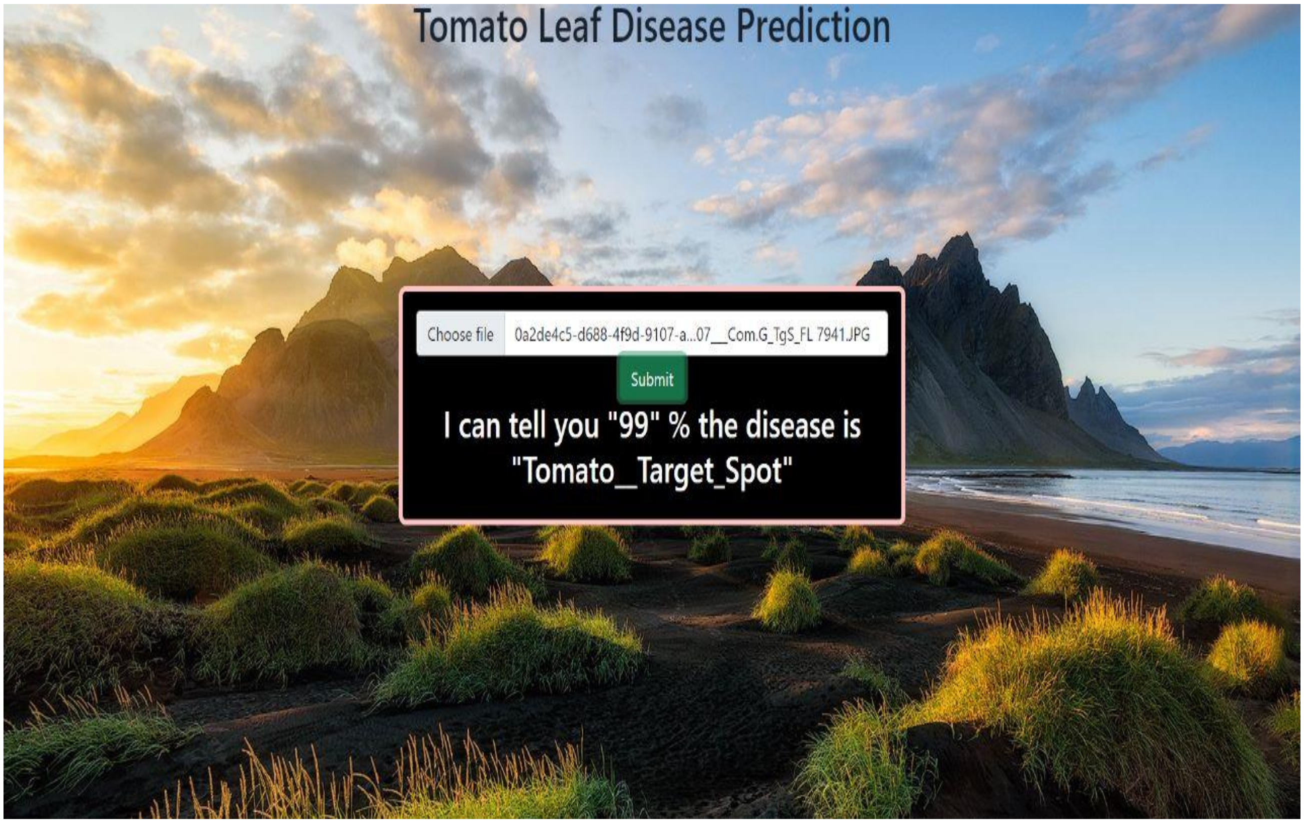
CHAPTER 5
RESULTS AND DISCUSSION

5.1 Home Page:

Whenever the user go to the website it will be redirected to the home i.e as shown in the below figure. Here the user can upload image of leaf.



5.2 Output Page:



CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

On implementing two machine learning models, Convolutional Neural Networks (CNN) and K-nearest Neighbors (KNN) on the disease detection of tomato leaves from the plant village dataset and also evaluating the aforementioned model using the following metrics: Accuracy, Precision, Recall and F1-Score, the study shows that CNN model performs better than the KNN model in the plant disease detection of tomato leaves by outperforming the KNN model is all of the four evaluation metrics. The study also makes use of the XAI technique Local Interpretable Model-agnostic Explanations (LIME) in order to provide explainability to the predictions made by the models. With the execution of a user study, this study is able to get feedback from farmers on if they trust the aforementioned AI and XAI models. The results from the user study indicate that the farmers find the predictions and explanations from AI and XAI models inadequate and therefore do not trust the implemented tools for the detection of plant diseases. However, through additional feeback the farmers highlight areas that could possibly help improve and trust the AI and XAI models.

6.2 Future Works

The dataset used in this study makes use of only tomato leaves from the plant village dataset. Due to the lack of enough Random Access Memory (RAM) storage the study had to be limited to only 10,000 images. In the future, it would be great to test the implementation of both the CNN and KNN model and also use LIME on the whole plant village dataset containing multiple different plants in order to bring detection and explainability to a wide variety of plants. Another work that this study would like to pursue in the future is to provide a comparative study on different XAI techniques and implement a user study in order to find out which XAI technique provides the best explainability, transparency and interpretability. With the addition of data on Volatile organic compounds, soil types, environmental conditions and time of the month as mentioned by farmers through feedback from the user study, the user trust of the detection tool is expected to grow a little higher. As discussed earlier in the use case of this study, a working application that is capable of taking pictures of plants and detecting plant diseases in real-time is the ideal goal and will prove to be of great use to the farmers and botany enthusiasts.

CHAPTER 7

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7.1 References

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