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Plant Disease Classification using Image Processing

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ABSTRACT: The agricultural sector is extremely significant to the country's economy. In many developing countries, agricultural productivity is critical. The agricultural sector is under pressure to develop new varieties of high-yielding crops as the world's population and life expectancy rise. The advancement of computer science technologies can be used to identify these diseases early on. Methods of image processing and classification are often used to detect disease in its early stages. Plant diseases have a major impact on crop quality and quantity. Image acquisition, image pre-processing, image segmentation, feature extraction, and classification are some of the image processing techniques used. Leaf diseases can be identified at an early stage, and crop yields can be improved. The features are extracted, and a subset of them is used to train CNN classifiers. Here we used a total of 300 images of 3 classes. This paper shows the disease of the leaf and its remedy. The system can be used for Plant Disease Classification and achieved by accuracy 99.97%.

CHAPTER 1

Introduction

1.1 Introduction

Food is a human's most important need in the world, and it is met by farmers who grow a variety of crops. However, in today's world, farmers face a variety of challenges when it comes to growing crops. The farmer is not affected by environmental issues, but he does experience a significant loss in agriculture as a result of various plant leaf diseases that reduce crop yield. 1st Farmers are losing money as a result of the rise in leaf diseases[2]. Crop yield is improved when leaf diseases are automatically classified at an early stage[4]. Various signs, such as spotty leaves and color changes in the leaves, can be used to detect the disease early on[5]. When a leaf is infected with a disease, its color changes. The color of a healthy leaf will vary from that of a diseased leaf[6]. Plant diseases have a major impact on crop quality and quantity [7]. Image acquisition, image preprocessing, image segmentation, feature extraction, and classification are some of the image processing techniques used. Leaf diseases can be identified at an early stage, and crop yields can be improved[8]. This paper established a segmentation technique for detecting and classifying plant leaf diseases automatically. In this paper used plant are tomato, potato, Pepper. The features are extracted, and a subset of them is used to train CNN classifiers.

1.2 Objectives Aim

- Detection of Plant Diseases Using Image Processing is the main focus. Farmers can quickly identify a plant's specific disease and treat it to improve farming productivity.
- The Disease's Fastest & Most Accurate Results.

1.3 Motivation

This being the motivation, the problem entitled "Leaf Disease Classification using Image Processing is proposed to assist the farmers technologically.

1.4 Problem statement

Keep a close eye on all of the signs that come with an illness. Make a mental or written note of the definition and verify to see if the assertion is valid without exception. Compare plants to see if they're affected in the same way in different parts of the industry. Check to see whether non-related plants are affected in the same way. The majority of disease-causing organisms are host-specific and do not affect a wide range of plant species. If the same leaf spot or burn appears on various plant types, we can expect toxic compounds to drift. Certain diseases, such as cotton root rot, can affect a variety of plants, but we can rule out corn and other grasses because they are not susceptible. Obtain as much information as possible to aid in the detection of the problem.

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Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

1.5 Limitation

The drawback is that we are actually limited to classifying single leaves that are facing up on a uniform backdrop. Although these are simple situations, a real-world application should be able to distinguish photos of the disease since it appears on the plant directly. Indeed, many diseases do not manifest themselves solely (or even at all) on the highest leaves of the plant, but rather on a variety of other parts of the plant. As a result, new image collection projects should aim to capture photographs from a wide range of viewpoints, preferably in as realistic an environment as possible.

CHAPTER 2

Background Theory

2.1 Preprocessing of Images

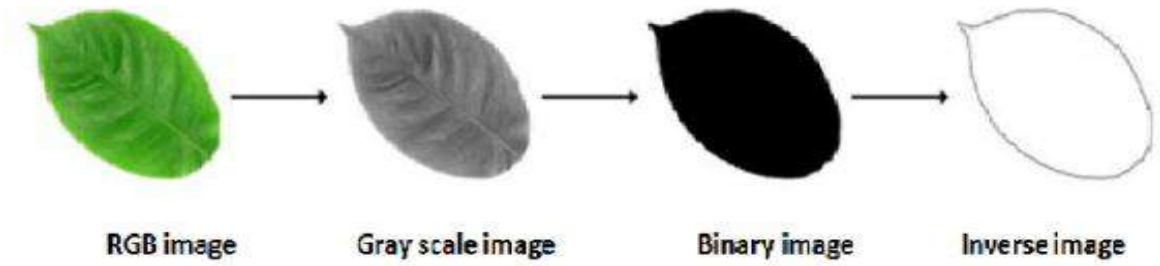

Figure 2.1: Preprocessing of Images

2.2 choose picture for testing disease

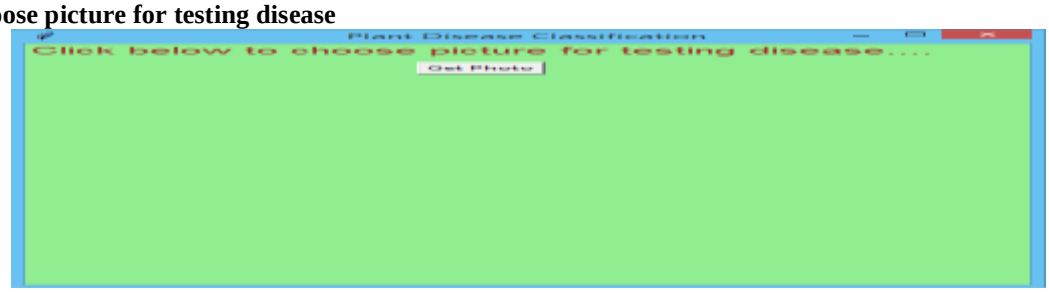

Figure 2.2 choose picture for testing disease

2.3 selected image

Figure2. 3selected image

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

2.4Result of plant disease

Figure 2.4 Result of plant disease

2.5Check Remedies

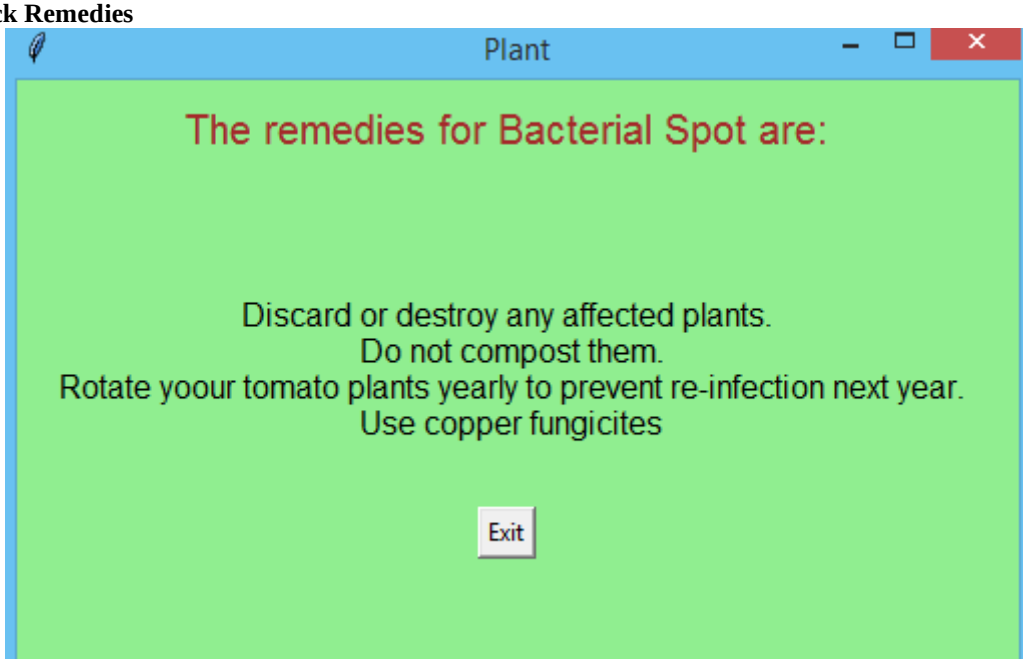

Figure 2.5 Check Remedies

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

2.6Accuracy

Image Uploaded Successfully

Result :

Disease Name : Tomato_Bacterial_spot

Accuracy : 99.97

Solution : Fertilizers: 1. Bonide Citrus, Fruit & Nut Orchard Spray (32 Oz) 2. Bonide Infuse Systemic Fungicide... 3. Hi-Yield Captan 50W fungicide (1... 4. Monterey Neem Oil

Figure 2.6 accuracy

CHAPTER 3

Brief Literature Review

3.1 Literature Survey

Research Paper 1

Paper 1:	**Plant Leaf Diseases Detection And Classification Using Image Processing And Deep Learning Techniques(2020)**
Author	Marwan Adnan Jasim, Jamal Mustafa AL-Tuwaijari
Year	2020
Conference	International Conference On Computer Science And Software Engineering
Description	Using deep learning methods, this paper introduces a method that can identify and diagnose plant leaf diseases. We've used certain types of plants in our work, such as tomatoes, peppers, and potatoes, because they're the most common types of plants on the planet, especially in Iraq. In our proposed scheme, we used a convolutional neural network to classify plant leaf diseases into 15 categories, including 12 classes for diseases detected in various plants, such as bacteria, fungi, and viruses, and three classes for stable leaves. In training and research, the result was extremely accurate[12].

Table 3.1 Literature Survey paper 1

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

Research Paper 2

Paper 2:	Image Processing Techniques For Detecting And Classification Of Plant Disease
Author	Gilbert GutabagaHungilo, Gahizi Emmanuel, Andi W. R. Emanuel
Year	2019
Conference	International Conference On Intelligent Medicine And Image Processing
Description	This paper examines current research in the field of image processing by examining techniques for detecting disease on plant leaves or fruits, as well as a machine learning model for classifying the disease. The primary goal of this paper is to define the current state of the art, explain steps taken during the image processing stage, and assess the merits and drawbacks of each technique used .the efficiency of the disease classification machine learning model This review paper would be useful to other researchers working in the field of image processing for detecting and classifying plant — leaves/fruit diseases in order to gain a better understanding of the current state of the art in the field.

Table 3.2 Literature Survey paper 2

Research Paper 3

Paper 3:	Plant Disease Identification And Classification Using Image Processing
Author	E.Vamsidhar, P.Jhansi Rani, K.Rajesh Babu
Year	2019
Conference	international Journal Of Engineering And Advanced Technology
Description	This paper established a segmentation technique for detecting and classifying plant leaf diseases automatically. Selected features are extracted and used to train and sustain vector machine and artificial neural network classifiers. The final results are satisfactoryAlternaria alternative (fungal), Anthracnose, Bacterial Blight (bacteria), Cercospora Leaf Spot, Bacterial leaf spot, frog eye leaf spot, sunburn disease, and stable leaves photos are among the datasets used.

Table 3.3 Literature Survey paper 3

Research Paper 4

Paper 4 :	**Detection And Classification Of Plant Diseases By Image Processing**
Author	NiketAmoda, Bharat Jadhav, PradnyaKurle, Sharon Kunder, SmeetaNaikwadi
Year	2018
Conference	International Journal Of Engineering Research & Technology
Description	We begin by constructing a colour transformation structure. The images are then segmented using the K-means Clustering Technique in the second step. We calculate the feel features for the segmented infected objects in the third step. Finally, the extracted features are trained in a pre-trained neural network in the fourth step. The K-means Clustering Algorithm attempts to classify objects based on a set of features into a set of K classes. Tomato early _scorch disease Plant Configuring Neural Networks For Recognition.

Table 3.4 Literature Survey paper 4

Research Paper 5

Paper 5:	**Plant Disease Detection And Classification Using Image Processing And Artificial Neural Networks**
Author	Mr. Sanjay Mirchandani1, Mihir Pendse, Prathamesh Rane, Ashwini Vedula
Year	2018
Conference	International Research Journal Of Engineering And Technology (IRJET)
Description	K-means clustering and Neural Networks are used in this paper to cluster and classify diseases that affect plant leaves. The introduced strategy focuses on recognising the disease in particular. Plant disease, mildew, Yellow Sigatoka, Tobacco Ringspot, Tomato Plant Disease, Frog Eye, and Valedinsia Leaf Spot were all used to test the Feed Forward and Cascaded Feed Neural Networks Algorithm. As compared to the Feed Forward approach, the cascaded Feed approach is superior because it needs less iterations because a smaller gradient value allows for faster adaptation and lowers the Mean Square Error.

Table 3.5 Literature Survey paper 5

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

Research Paper 6

Paper 6:	**Detection And Classification Of Plant Leaf Diseases In Image Processing Using MATLAB**
Author	Malti K. Singh, Subrat Chetia
Year	2017
Conference	International Journal Of Life Sciences Research
Description	Image acquisition, image preprocessing, image segmentation, feature extraction, and classification are all part of this process. For the classification of objects assisted by a group of features into K number of groups, K- mean clustering is completed. By minimising the number of squares of the space between data objects and corresponding clusters, the classification is completed.

Table 3.6 Literature Survey paper 6

Sr No	**Paper Name**	**Year**	**Advantages**	**Disadvantages**
1	Plant Leaf Diseases Detection And Classification Using Image Processing And Deep Learning Techniques	2020	Robust methodology to detect and classify diseases with accurate results based on computer facilities and Deep Learning Techniques.	Take time during the training process.
2	Image Processing Techniques For Detecting And Classification Of Plant Disease	2019	This approach learns to go away features directly from the input image, so there's no need for handcraft features extraction just like the conventional method. 2) This method are often wont to detect various diseases from different leaves of plant species which is different from the traditional method most wont to detect disease affect one plant species.	Conventional methods perform well when dealing with one type of plant leaves or fruits. But the approach needs a lot of trial and error in its pipelined procedures of detecting and classification of disease.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

3	Plant Disease Identification And Classification Using Image Processing	2019	Prediction accuracy is high Good potential with ability to detect plant leaf disease	Involve long training time, difficult to understand learned function Require more time

3.2 Comparative Study

3.2.1Some Advantages and Disadvantages are summarized as follows:

Table 3.2.1Some Advantages and Disadvantages are summarized

4	Detection And Classification Of Plant Diseases By Image Processing	2018	Easy to implement and quite good in result.	Slow learner
5	Plant Disease Detection And Classification Using Image Processing And Artificial Neural Networks	2018	The Feed Forward and Cascaded Feed algorithms can be expanded for detection of multiple diseases on a significantly large scale.	reduces the Mean Square Error.
6	Detection And Classification Of Plant Leaf Diseases In Image Processing Using MATLAB	2017	farmers in the classification of diseases at an early or initial stage and provide useful information for its control.	reduces the accuracy of the model

Sr No	**Paper Name**	**Year**	**Author**	**Classification**	**techniques**	**Dataset**	**accuracy**

1	Plant Leaf Diseases Detection And Classification Using Image Processing And Deep Learning Techniques	2020	Marwan Adnan Jasim, Jamal Mustafa AL-Tuwaijari	CNN algorithm	Texture And Color Attribute Extraction ,Deep Learning, image processing	Plant Village dataset	91%
2	Image Processing Techniques For Detecting And Classification Of Plant Disease	2019	Gilbert GutabagaHungilo, Gahizi Emmanuel, Andi W. R. Emanuel	Convolutional neural network	image processing, Texture And Color Attribute Extraction	open dataset of 87,848 Images	95%
3	Plant Disease Identification And Classification Using Image Processing	2019	E.Vamsidhar, P.Jhansi Rani, K.Rajesh Babu	SVM , ANN	image processing, Color Attribute Extraction	Alternaria alternate (fungal), Anthracnose, Bacterial Blight (bacteria), Cercospora Leaf Spot, Bacterial leaf spot, frog eye leaf spot, sun burn disease and healthy leaves images	94.23%

International Journal of Advances in Engineering and Management (IJAEM)
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3.2.2Summary of reviewed article various Classification and techniques, Dataset, accuracy with their corresponding performance measures

Table 3.2.2Summary of reviewed article various Classification and techniques, Dataset, accuracy with their corresponding performance measures

4	Detection And Classification Of Plant Diseases By Image Processing	2018	NiketAmoda, Bharat Jadhav, PradnyaKurle, Sharon Kunder, Smeeta Naikwadi	Neural Network.	The Edge Detection, Layers Separation Technique, K-means Clustering	Tomato_early _scorch	95%
5	Plant Disease Detection And Classification Using Image Processing And Artificial Neural Networks	2018	Mr. Sanjay Mirchandani1, Mihir Pendse, Prathamesh Rane, Ashwini Vedula	Neural Networks :Feed Forward Back Propagating Neural Network , Cascaded Feed Back Propagating Neural Network	K-means Clustering, And The Edge Detection, Layers Separation Tec	Black Spot, Powdery Mildew, Yellow Sigatoka, Tobacco Ringspot, Tomato Leaf Disease, Frog Eye AndValedinsia Leaf Spot	90%
6	Detection And Classification Of Plant Leaf DiseasesIn ImageProcessing Using MATLAB	2017	Malti K. Singh, Subrat Chetia	Back Propagation Neural Network	Zooming Algorithm, SOM Neural Network, K-means Clustering	Phaseolus Vulgaris (Beans) And Camellia Assamica (Tea)	91%

3.2.2.1 Accuracy Comparisons

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

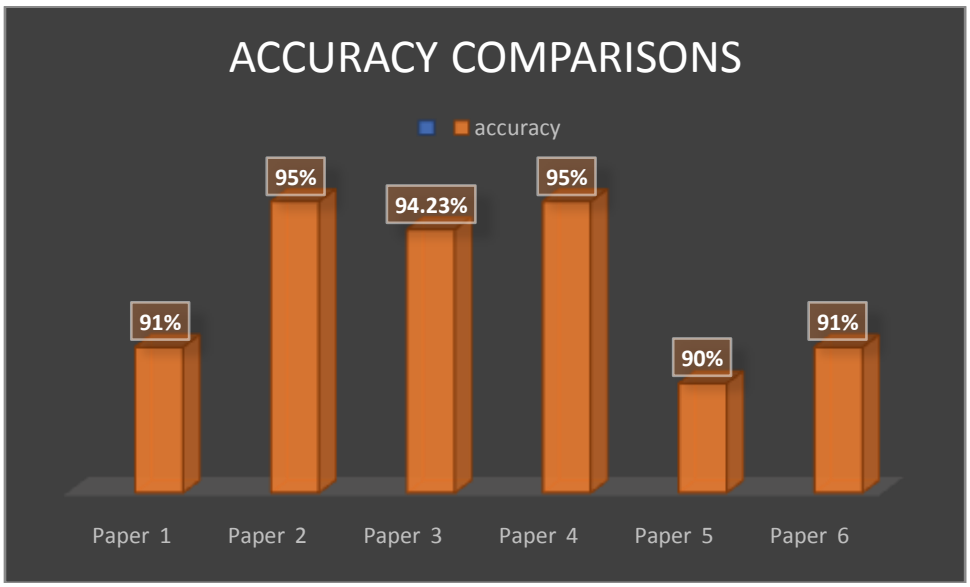

Figure 3.2.2.1 Accuracy Comparisons

CHAPTER 4

Proposed System

4.1 Existing Work

- First, the leaf images are captured, then image processing techniques are applied to extract useful features for disease detection.

The block diagram of the proposed methodology is shown in Figure 4.1 Block Diagram of proposed method.

A. Image Acquisition

In the image acquisition step, images of plant leaves are acquired to perform some operations on images in the Image processing system[20]. The images can be acquired through a digital camera or can be downloaded from an authenticated plant image site. The acquired images and their features are stored in a picture database[21]. The image database consists of a healthy set and a diseased set of images[22]. The efficiency of the image database depends on the eminence of images so the images should be of high quality[23]. The efficiency of the database defines the vigor of the system[24]. The images are altered into device-independent color space[25].

B. Image pre-processing

The pre-processing techniques are accomplished to form the image applicable for further processing. The image is resized in preprocessing step of disease classification. The pre-processing of images consists of image expansion, color alteration, removal of noise. In Image enhancement, the quality of the image is enhanced to increase the visuality. In color space conversion, the RGB image is converted into greyscale using various color models like CIELAB, YCbCr, and HSV.

C. Feature Extraction

This phase aims to extract features like color and shape. Two shape features like area and perimeter are extracted from the binary segmentation images. Color features are extracted from color segmentation images. the color features include the meaning of gray values of R/G/B component, the variance of gray values of R/G/B component, skewness of gray values of R/G/B component, the color ratio in RGB color model, mean of gray values of H/S/V component, the variance of gray values of H/S/V component, and skewness of gray values of H/S/V component [11].

E. Leaf Image Classification For classification between the affected leaves, classifiers depend on the CNN were used for classification and differences between the affected leaves [12].

D. Leaf Image Classification

For classification between the affected leaves, classifiers depend on CNN were used for classification and differences between the affected leaves [12].

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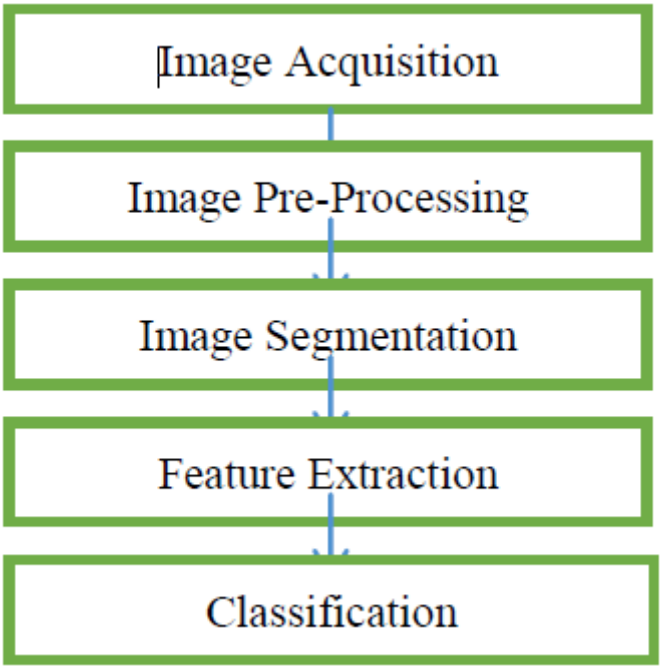

Figure4.1 Block Diagram of proposed method

4.2Proposed System

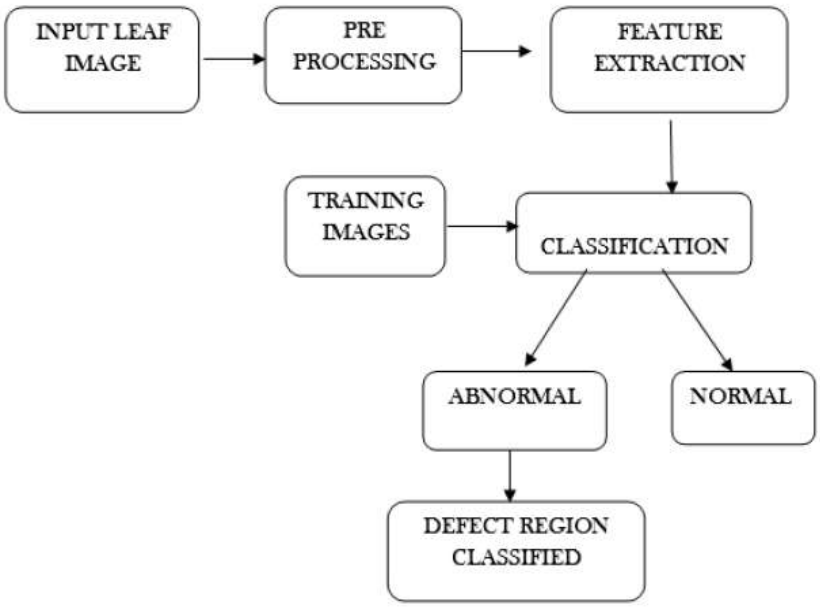

Figure4.2 Proposed Process Flow

In order to diagnose the cause of the symptom by using an automated tool, so image processing system is proposed to develop to automate the classification of the leaf batches into a specific disorder. As shown in the figure above the system consists of main blocks: input leaf Image, preprocessing, segmentation, feature extraction, classification. A large set of defective images are processed by an image analyzer for extracting abnormal features. Then these features are stored in the feature database for later usage by the classifier.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

4.3 Data Flow Diagram

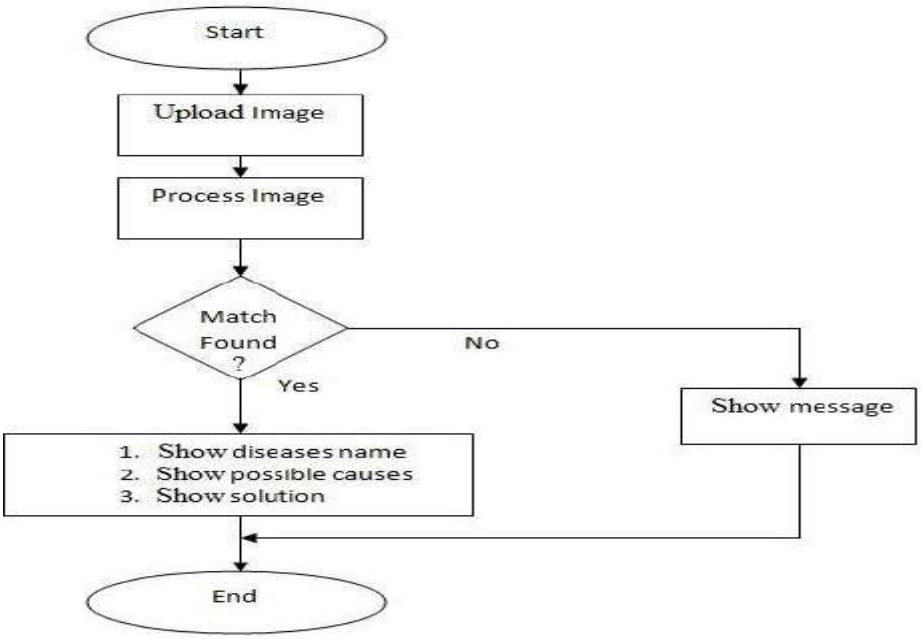

Figure 4.3Data Flow Diagram

CHAPTER 5

Implementation And Results

5.1 Implementation Environment

Implementation Language: Python.
Hardware: 4GB RAM, i3 Processor**.**
Software: Python Web App
Operating System: Windows 8.1

5.2 Dataset

Plant Village dataset consists of 300 images of different plant leaves which are divided into 3 classes. The dataset consists of 3 types of plant species and 15types of plant diseases. The dataset contains both healthy and diseased crop images[3]. . In this paper used plant are tomato, potato, Pepper.

```
['Pepper__bell___Bacterial_spot', 'Pepper__bell___healthy', 'Potato___Early_blight',
'Potato___healthy', 'Potato___Late_blight', 'Tomato_Bacterial_spot',
'Tomato_Early_blight', 'Tomato_healthy', 'Tomato_Late_blight', 'Tomato_Leaf_Mold',
'Tomato_Septoria_leaf_spot', 'Tomato_Spider_mites_Two_spotted_spider_mite',
'Tomato__Target_Spot', 'Tomato__Tomato_mosaic_virus',
'Tomato__Tomato_YellowLeaf__Curl_Virus']
```

Figure 5.2 Dataset

5.3 Implementation

5.3.1 App.py

```
import os
import warnings
warnings.simplefilter("ignore")
```

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

```
import tensorflow as tf
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model
import numpy as np
import cv2
from flask import Flask, request, render_template
from tensorflow.keras import backend as K
from os import listdir
K.clear_session()

app = Flask(__name__)

APP_ROOT = os.path.dirname(os.path.abspath(__file__))
im = ''
result = '...'
percentage = '...'
i = 0
imageName = ''
solution = ''
@app.route("/")
def index():
    return render_template("upload.html")
@app.route("/upload", methods=["POST"])
def upload():
    global im, result, percentage ,i , imageName , solution
    target = os.path.join(APP_ROOT, 'static\\')
print(f'Target : {target}')
    if not os.path.isdir(target):
os.mkdir(target)
    for imgg in os.listdir(target):
        try:
imgPath = target + imgg
os.remove(imgPath)
print(f'Removed : {imgPath}')
        except Exception as e:
            print(e)
    for file in request.files.getlist("file"):
print(f'File : {file}')
i += 1
imageName = str(i) + '.JPG'
        filename = file.filename
        destination = "/".join([target, imageName])
print(f'Destination : {destination}')
file.save(destination)
print('analysing Image')
        try:
            image = os.listdir('static')
im = destination
print(f'Analysing Image : {im}')
        except Exception as e:
            print(e)
        result = "Failed to Analyse"
        percentage = "0 %"
        try:
detect()
            solution = solutions(result)
```

International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 6 June 2021, pp: 77-96 www.ijaem.net ISSN: 2395-5252

```
        except Exception as e:
print(f'Error While Loading : {e}')
    return render_template('complete.html', name=result, accuracy=percentage , img = imageName , soln = solution)
def detect():
    global im, result, percentage
print(f'Image : {im}')
    # resolution
ht=50
    wd=50
classNames = ["Pepper__bell___Bacterial_spot", "Pepper__bell___healthy" , "Potato___Early_blight" , "Potato___healthy" , "Potato___Late_blight" ,
        "Tomato_Bacterial_spot","Tomato_Early_blight","Tomato_healthy",
                "Tomato_Late_blight","Tomato_Leaf_Mold","Tomato_Septoria_leaf_spot",
                "Tomato_Spider_mites_Two_spotted_spider_mite","Tomato__Target_Spot",
                "Tomato__Tomato_mosaic_virus","Tomato__Tomato_YellowLeaf__Curl_Virus"]
totClass = len(classNames)
    print(classNames)
    print(totClass)
    mdl = r"LeafDisease50x50.h5"
    image = cv2.imread(im)
orig = image.copy()
    try:
        image = cv2.resize(image, (ht, wd))
        image = image.astype("float") / 255.0
        image = img_to_array(image)
        image = np.expand_dims(image, axis=0)
    except Exception as e:
print("Error Occured : ",e)
    # load the trained convolutional neural network
    print("[INFO] loading network...")
    model = load_model(mdl)
    (zero, one,two, three,four,five,six,seven, eight,nine, ten , eleven, twelve , thirteen , fourteen) = model.predict(image)[0]
    prob = [zero, one,two, three,four,five,six,seven, eight,nine, ten , eleven, twelve , thirteen , fourteen]

maxProb = max(prob)
maxIndex = prob.index(maxProb)
    label = classNames[maxIndex]
proba = maxProb
    result = label
    percentage = float("{0:.2f}".format(proba * 100))
    for i in range(0,totClass):
        print(f'{classNames[i]} : {prob[i]}')
Tomato_Bacterial_spot = """
Fertilizers:
1. Bonide Citrus, Fruit & Nut Orchard Spray (32 Oz)
2. Bonide Infuse Systemic Fungicide...
3. Hi-Yield Captan 50W fungicide (1...
4. Monterey Neem Oil
"""
Tomato_Early_blight = """
\n
1. Mancozeb Flowable with Zinc Fungicide Concentrate
2. SpectracideImmunox Multi-Purpose Fungicide Spray Concentrate For Gardens
3. Southern Ag – Liquid Copper Fungicide
```

4. Bonide 811 Copper 4E Fungicide
5. Daconil Fungicide Concentrate.
"""
Tomato_healthy = """
\nYour Plant Is Healthier.
"""
Tomato_Late_blight = """
\n
Plant resistant cultivars when available.
Remove volunteers from the garden prior to planting and space plants far enough apart to allow for plenty of air circulation.
Water in the early morning hours, or use soaker hoses, to give plants time to dry out during the day — avoid overhead irrigation.
Destroy all tomato and potato debris after harvest.
"""
Tomato_Leaf_Mold = """
\nFungicides :
1. Difenoconazole and Cyprodinil
2. Difenoconazole and Mandipropamid
3. Cymoxanil and Famoxadone
4. Azoxystrobin and Difenoconazole

"""
Tomato_Septoria_leaf_spot = """
\n
Use disease-free seed and dont save seeds of infected plants
Start with a clean garden by disposing all affected plants.
Water aids the spread of Septoria leaf spot. Keep it off the leaves as much as possible by watering at the base of the plant only.
Provide room for air circulation. Leave some space between your tomato plants so there is good airflow.

"""
Tomato_Spider_mites_Two_spotted_spider_mite = """
\n
Prune leaves, stems and other infested parts of plants well past any webbing and discard in trash (and not in compost piles). Don't be hesitant to pull entire plants to prevent the mites spreading to its neighbors.
Use the Bug Blaster to wash plants with a strong stream of water and reduce pest numbers.
Commercially available beneficial insects, such as ladybugs, lacewing and predatory mites are important natural enemies. For best results, make releases when pest levels are low to medium.
Dust on leaves, branches and fruit encourages mites. A mid-season hosing (or two!) to remove dust from trees is a worthwhile preventative.
Insecticidal soap or botanical insecticides can be used to spot treat heavily infested areas.
"""
Tomato__Target_Spot = """
1. Remove old plant debris at the end of the growing season; otherwise, the spores will travel from debris to newly planted tomatoes in the following growing fc, thus beginning the disease anew. Dispose of the debris properly and don't place it on your compost pile unless you're sure your compost gets hot enough to kill the spores.

2. Rotate crops and don't plant tomatoes in areas where other disease-prone plants have been located in the past year – primarily eggplant, peppers, potatoes or, of course – tomatoes. Rutgers University Extension recommends a three-year rotation cycle to reduce soil-borne fungi.

3. Pay careful attention to air circulation, as target spot of tomato thrives in humid conditions. Grow the plants in full sunlight. Be sure the plants aren't crowded and that each tomato has plenty of air circulation. Cage or stake tomato plants to keep the plants above the soil.

4. Water tomato plants in the morning so the leaves have time to dry. Water at the base of the plant or use a soaker hose or drip system to keep the leaves dry. Apply a mulch to keep the fruit from coming in direct contact with the soil. Limit to mulch to 3 inches or less if your plants are bothered by slugs or snails.

5. You can also apply fungal spray as a preventive measure early in the season, or as soon as the disease is noticed.

```
"""
Tomato__Tomato_mosaic_virus = """
\n
Fungicides will not treat this viral disease.
Avoid working in the garden during damp conditions (viruses are easily spread when plants are wet).
Frequently wash your hands and disinfect garden tools, stakes, ties, pots, greenhouse benches, etc.
Remove and destroy all infected plants.Do not compost.
Do not save seed from infected crops.
"""
Tomato__Tomato_YellowLeaf__Curl_Virus = """
\n
Use a neonicotinoid insecticide, such as dinotefuran (Venom) imidacloprid (AdmirePro, Alias, Nuprid, Widow, and others) or thiamethoxam (Platinum), as a soil application or through the drip irrigation system at transplanting of tomatoes or peppers.
Cover plants with floating row covers of fine mesh (Agryl or Agribon) to protect from whitefly infestations.
Practice good weed management in and around fields to the extent feasible.
Remove and destroy old crop residue and volunteers on a regional basis.
"""
def solutions(disease):
   switcher = {
      "Tomato_Bacterial_spot": Tomato_Bacterial_spot ,
      "Tomato_Early_blight": Tomato_Early_blight ,
      "Tomato_healthy": Tomato_healthy ,
      "Tomato_Late_blight" :Tomato_Late_blight,
      "Tomato_Leaf_Mold" :Tomato_Leaf_Mold,
      "Tomato_Septoria_leaf_spot" :Tomato_Septoria_leaf_spot,
      "Tomato_Spider_mites_Two_spotted_spider_mite" :Tomato_Spider_mites_Two_spotted_spider_mite,
      "Tomato__Target_Spot" : Tomato__Target_Spot,
      "Tomato__Tomato_mosaic_virus" : Tomato__Tomato_mosaic_virus,
      "Tomato__Tomato_YellowLeaf__Curl_Virus" : Tomato__Tomato_YellowLeaf__Curl_Virus,
      }
   return switcher.get(disease,"Not Found In The List")

if __name__ == "__main__":
app.run(port=4555, debug=False)
```

5.3.2Machine Learning Algorithm Comparison

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```
import numpy as np
import matplotlib.pyplot as plt

# data to plot
n_groups = 5
means_profile = (0.86,0.88,0.92,0.79,0.72)

# create plot
fig, ax = plt.subplots()
index = np.arange(n_groups)
bar_width = 0.20
opacity = 1

rects1 = plt.bar(index, means_profile, bar_width,
                 alpha=opacity,
                 color='b',
                 label='')


plt.xlabel('LR                    LDA                KNN                RF                SVM')
plt.ylabel('Mearsures')
plt.title('Machine Learning Algorithm Comparison')
plt.legend()

plt.tight_layout()
plt.show()
```

5.3.2.1Machine Learning Algorithm Comparison output

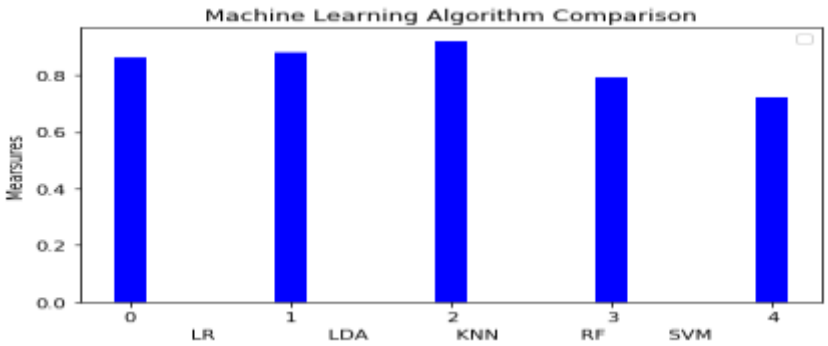

Figure 5.3.2.1 Machine Learning Algorithm Comparison output

CHAPTER 6

Conclusion

By this Methodology, we can assure with managing all sorts of identification of problems such as assembly line product identification, fruits or vegetables disease identification reduces the number of plants dying thanks to improper identification of disease. The main aim was to learn and design a machine learning application development inside a python web App. Providing the flexibility of implementation of TensorFlow framework and CNN classification inside any environment. The system can be used for Plant Disease Classification and achieved by accuracy 99.97%.

CHAPTER 7

Future work

This project has much room for future work, alone or a future interested student.

1. The first changes that need to be made, as stated above, are further testing with the improved dataset.
2. Improved TensorFlow design. The network at the moment is still basic, and much more research and practice are needed to optimize the design.
3. The dataset itself is often further improved by adding images, removing undesired ones, adding or removing classes, and by making the image content more specific, as within the Flavia dataset.
4. A web application can be created for use by average users or scientists working in the field.

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