A

Major Project

On

THE ANALYSIS OF PLANTS RECOGNITION BASED ON DEEP LEARNING AND ARTIFICIAL NEURAL NETWORK

(Submitted in partial fulfillment of the requirements for the award of Degree)

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled **"THE ANALYSIS OF PLANT RECOGNITION BASED ON DEEP LEARNING AND ARTIFICIAL NEURAL NETWORK"** being submitted by **J. MAMATHA (167R1A05E2), B. DHANUSH RAO (177R1A0506), E. RAM CHARAN (177R1A0511), P. MANOJ REDDY (177R1A05A2)** in partial fulfillment of the requirements for the award of the degree of B.Tech in Computer Science and Engineering to the Jawaharlal Nehru Technological University Hyderabad, is a record of bonafide work carried out by him/her under our guidance and supervision during the year 2021-22.

The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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ACKNOWLEGDEMENT

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ABSTRACT

Classification and identification of plants are helpful for people to effectively understand and protect plants. The leaves of plants are the most important recognition organs. With the development of artificial intelligence and machine vision technology, plant leaf recognition technology based on image analysis is used to improve the knowledge of plant classification and protection. Deep learning is the abbreviation of deep neural network learning method and belongs to neural network structure. It can automatically learn features from big data and use artificial neural network based on back propagation algorithm to train and classify plant leaf samples. The main content of this paper is to extract plant leaf features and identify plant species based on image analysis. Firstly, plant leaf images are segmented by various methods, and then feature extraction algorithm is used to extract leaf shape and texture features from leaf sample images. Then the comprehensive characteristic information of plant leaves is formed according to the comprehensive characteristic information. In this paper, 50 plant leaf databases are tested and compared with KNN-based neighborhood classification, Kohonen network based on self-organizing feature mapping algorithm and SVM-based support vector machine. At the same time, the leaves of 7 different plants were compared and it was found that ginkgo leaves were easier to identify. For leaf images under complex background, good recognition effect has been achieved. Image samples of the test set are input into the learning model to obtain reconstruction errors. The class label of the test set can be obtained by reconstructing the deep learning model with the smallest error set. The results show that this method has the shortest recognition time and the highest correct recognition rate.

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1.INTRODUCTION

1.Introduction

The classification of plants and different types and classes of creatures is one of the most important fields of biology. All creatures are classified into classes and sub- classes based on the similarity and dissimilarity among them. The word “taxonomy” is derived from the Ancient Greek: τάξις which means arrangement or classification; and νομία which means method. So it means the science that is interested in the methods of classification of plants and animals.

The classification of plants is very important in grouping plants into different ranks and classes based on different classifiers or categories. It puts each group of plants having some common properties into classes. Also the classes are then divided into sub-classes and types to differentiate among the elements of the class. This classification is very important to help scientists to study the common behaviors and properties of the plants. Especially those plants used in the medicine or medical plants.

In the past before the invention of digital cameras and computerized systems; people were using their own absolute experience in defining different types of medical plants. The risqué of using the wrong plant for medicine extraction increases with the lack of experience and can cause fatal error that can cause the death of some patients. The existence of digital devices and possibilities of computer vision has encouraged the botanists and computer scientists to develop computerized systems or semi automatic systems for plant classification or recognition based on different features. Different researches have treated the problems of the plant classification and mentioned different methods of recognition for these plants. Expert systems were considered also in the plant recognition and classification task.

The last century has seen a very great development in CNNintelligence and machine vision where a lots of pattern recognition and classification tasks were investigated by using automatic computer systems. These applications include finger print recognition which has been developed and face recognition which is developing increasingly.

CNN networks have entered the race of pattern recognition and classification for decades due to their simplicity of implementation and ease of use; in addition to their flexibility for different applications and the high efficiency that they achieved. The development of digital processors has also encouraged the use of neural networks in many sciences. Neural networks use mathematical equations to imitate the structural construction and functional principle of the biological brain. Neural networks implement a structure similar to human brain to learn the pattern among different elements and apply themselves based on the acquired knowledge. This knowledge is then applicable on other elements that may have the same pattern or not.

Neural network systems gain their knowledge and develop their experience over the time by using examples to reinforce the weights of connections between their neurons. They use the example and error in repetitive check and adaptation or rearrangement of themselves to suit the system they are trying to describe. This repetitive task is called training or learning of neural networks. Whenever the networks develop a correct relation between their input and output examples then they are called to be trained.

This thesis concentrates on the employment of ANN system to classify different medical plants and differentiate among them using their leaves. Different leaves collected arbitrary from different medical plants and their images were taken using a digital camera. The images were then processed and used in the training of a neural network computer system. Results and methods are described and discussed in the thesis [1].The aim of this thesis is the development of CNNneural networks for recognition of leaves. Thesis includes five chapters and conclusion. Chapter 1 presents a brief introduction to CNNIntelligence and also describes fuzzy logic, expert

systems, genetic algorithms and neural networks. Chapter 2, explains briefly CNNNeural Networks. It describes the history and the back propagation learning algorithm.

The implementation of the noise and processing of the images is an important stage in the recognition procedure. The processing of the images is done by using MATLAB which includes adding the noise to the images in addition to resizing and changing the type of images to reduce processing expenses. The pre-processing stage is a very important stage for a prosperous recognition rule. The choice of image size is important as it affects directly the results of the program in addition to the running time.

2.LITERATURE SURVEY

2.Literature Survey

2.1 CNN Intelligence

CNNIntelligence is one of the branches of the Computer Science that tries to develop systems that can think like human beings to solve complex problems. The intelligence that is the ability to reason in the system is “artificial” that is designed by man. In general CNN Intelligence has strong ties with other branches of Science like *Philosophy, Biology, Maths*, *Psychology*, *and Cognition.*

Computers are suitable to carry out computations, using unchangeable programmed principles. This property permits CNNsystems to operate efficiently and correctly in high speed over and over again, whereas for human beings doing so is not easy. But on the other hand contrary to human intelligence, computers have difficulties in knowing exact conditions and conforming to new conditions. CNNIntelligence helps to make better machine behavior in tackling complex tasks.

2.2 Genetic Algorithm

Genetic Algorithm is adaptive discovery research algorithm based on development opinions nature choice and genes. As like Gens display an intelligent development of a randomly investigate employed to find solution improvement trouble. Genetic Algorithm no signify randomly, in place of their use to advantage the past knowledge to straight the research inside of regional better carrying out between the research area.

Genetic algorithms superior than usual CNNIntelligence in that Genetic algorithm is greater strong. Different not newer CNNIntelligence systems, They do not break easy ,if enters altered very little, or in the manner of person noise. And also, in researching a big condition-area, multi-modal condition-area, or n- dimensional outer side, a genetic algorithm may suggest with

meaning advantages above greater normal research of making the best methods like linear program development, depth-first, breath-first implementation.

2.3 Fuzzy Logic

Fuzzy logic is approaching to compute based on “level of truth” prefer other the normal “true or false” (1 or 0) Boolean logic of the present time computer is based. Dr. Lotfi Zadeh’s opinion of the fuzzy logic was initially advancing the University of California at Berkeley in 1960s. Dr. Zadeh worked on troubles of computer understand of nature languages. Nature language (as greatest others activity in existence and in truth the world) is not easy to translate inside of the complete periods of 0 and 1. Fuzzy logic contains 0s and 1s, like farthest instances of truth and also but contains some conditions of fact among because, for instance, the ending of comparing among two stuffs could not be “tall” other “short” but “38 of tallness”. People summed information and shape a number of incomplete facts that people summed very far in much high from facts that successively, only if sure beginnings are went over, reason inevitable very far ends so like machine action as a result. It may aim to understand fuzzy logic like the technique use of reason in fact be employed and

Boolean logic other binary is very easy exceptional instance of it.

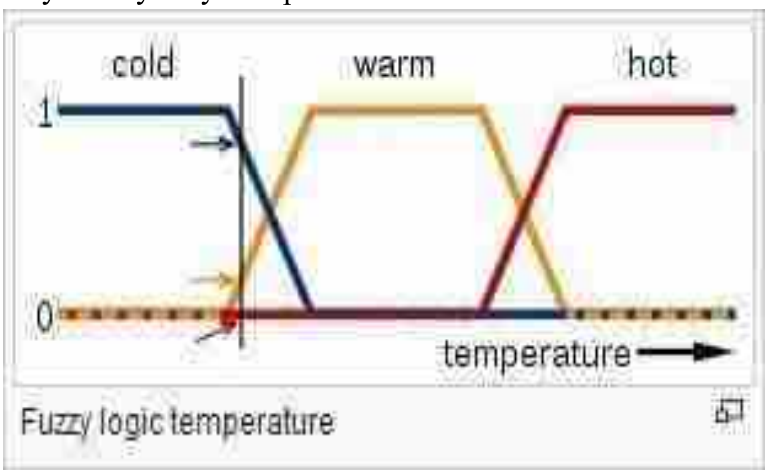


Fig 2.1: Fuzzy Logic

2.4 Neural Network

It is a concept of processing data based on the way neurons in brains process information and communicates with each other. Neural computing is performed using CNN Neural Networks (ANN). The brain consists of neurons. It is highly complex, on linear and parallel computer. Basic ANN architectures can be seen. It has the capability to organize the neurons so as to perform. Certain computations many times faster that the fastest digital computer in existence.

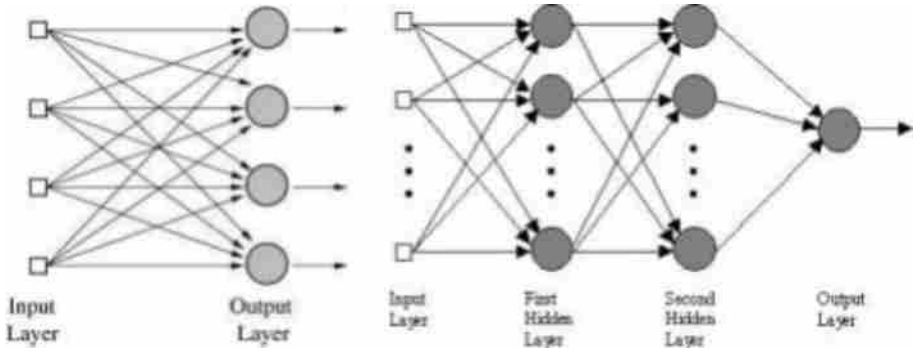


Fig 2.2: Basic CNN Neural Network Architectures

2.5 Learning Models

The learning process inside CNNneural networks is an outcome of changing the network's weights, with a few type of learning paradigms. The object is to learn a set of weight matrices that when implemented to the network should expectantly map any input output. to make corrections output.

2.5.1 Supervised Learning

In a supervised learning process, the input data and its corresponding output are presented to the neural network. The network will accord a defined low, change its weights in order to be able to reproduce the correct output, when an input is given. Example of neural network based on supervised Learning.

2.5.2 The Perceptron

A perceptron model can be trained and can make decisions. During the training phase, pairs of input and output vectors are used to train the network. With each input vector, the output vector is compared with the desired output(target),and the error between the actual output and the target is used to update the weights.

2.5.3 Back Propogation Algorithm

A multilayer network can be trained using the back propagation learning algorithm. This involves presenting pairs of input and output vectors. The actual output for a given input vector is compared with the target output. If there is no difference, the weights do not change. Otherwise, the weights are adjusted to reduce the difference. This learning algorithm uses a gradient search technique to minimize the cost function that is equal to the mean square difference between the target and the actual output .The network is initialized by setting random weights and thresholds.

2.5.4 Unsupervised Learning

An unsupervised learning process requires only input vectors to train the network. Once the input data is presented the neural network, the weights are adjusted in an order way according to some defined figure of merit. Below it is given examples of Unsupervised
Learning processes.

2.6 CNN Neural Network Applications For Leaves Recognition

2.6.1 Historical Overview Of Leaves Recognition

There has been substantial work in recent years in the field for leaf biometric recognition. Initially it was approached by Petry. He classified weed species based on shape and structure of leaves to automatically. This morphological feature extraction technique has been used many times. (Stephen Gang Wu, 2007) used twelve morphological features

(including vein features)and a neural network to achieve 90.3% classification accuracy.

By using eleven morphological features Knight (2010) achieved a classification accuracy of 80%. This approach was implemented as a mobile application designed for field guides.

However, this has the disadvantage that dry leaves cannot be used as they will be a different color from a leaf that has just been picked. Ehsanirad (2010) used a Gray-Level Co-occurrent Matrix (GLCM) and Principal Component Analysis (PCA) to achieve classification accuracies of 78.46% and 98.46% respectively. Using a Probabilistic Neural Network with, K. Singh (2010) achieved 91% classification accuracy.

2.6.2 Why Leaves Recognition?

Plants are an inherent of ecosystem. A lot of plant samples are into the danger of annihilation. Plants are very important beneficial for humanity being and other living vitals. Plants are beneficial to nourishment, to medical and also into a lot of industries. Plants Identifying supports insure to protective and survive of all natural life. Plant identification can be implemented a lot of various methods using the plant's leaves. . Classify plants to leaves are useful, Leaves are a lot of easily opportunity the other biometric elements the same as flowers are opportunity for duration of time. Different Biometric qualities of leaf as the same as color, venation, tissue, shape, in Plant classification needs to use. Leaves can classify as on color that inclusion semblance among both of two images the support of color, but color classification is related impression of sunlight on season.

2.6.3 Find the leaf venation pattern

Canny edge detection method is utilized for finding the venation pattern of the leaves. In the first stage of this method the leaf images are smoothed in order to remove the noise. Next stage involves finding the gradients with high magnitude by local maxima for identifying veins. Then veins are highlighted where high values of spatial derivatives are found. Edge candidates

are selected after double thresholding. Finally veins are detected by eliminating veins that are not connected to strong veins.

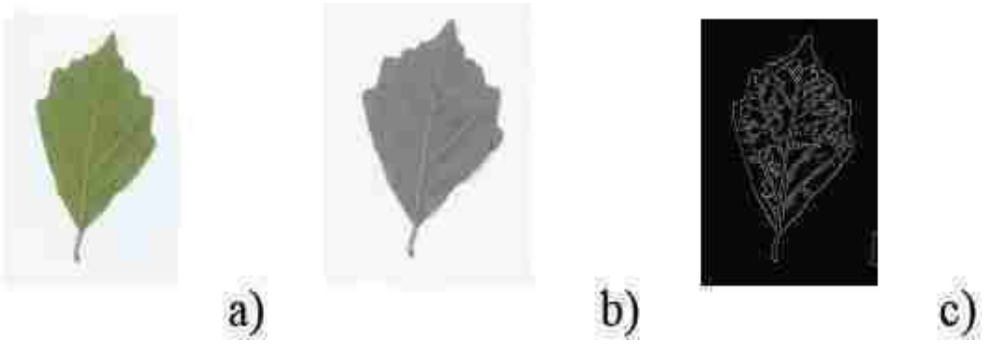


Fig 2.3: Leaf Images a) original b) gray scale c) venation Pattern

Leaf images are converted to gray scale images to avoid the potential negative effects of the variations in the color caused by the sunlight.

3.SYSTEM ANALYSIS

3.System Analysis

3.1 Existing System:

There are abundant ecological resources on the earth,and plants are the most important part of ecological resources.It is estimated that there are about hundreds of thousands of existing plants.They have different shapes,structures and lifestyles.Inorder to understand and make better use of plants,plants must be classified.The results might not be perfect.

3.2 Hardware Requirements:

- RAM : 4GB
- HARD DISC : 500GB

3.3 Software Requirements:

- Operating System : Windows 7 & above.
- Languages used : Python
- Domain : Machine Learning / Deep Learning.

4.PROPOSED SYSTEM

4.Proposed System

4.1 Proposed System

This chapter first introduces the process of image feature extraction and image classification. Through the analysis of the concept and principle of image processing technology, the edge segmentation method in plant image processing is introduced. In the experimental part, through analyzing the performance parameters of the image structure before and after image segmentation, the comparison results of image segmentation filtering optimization simulation.

4.2 Methodology

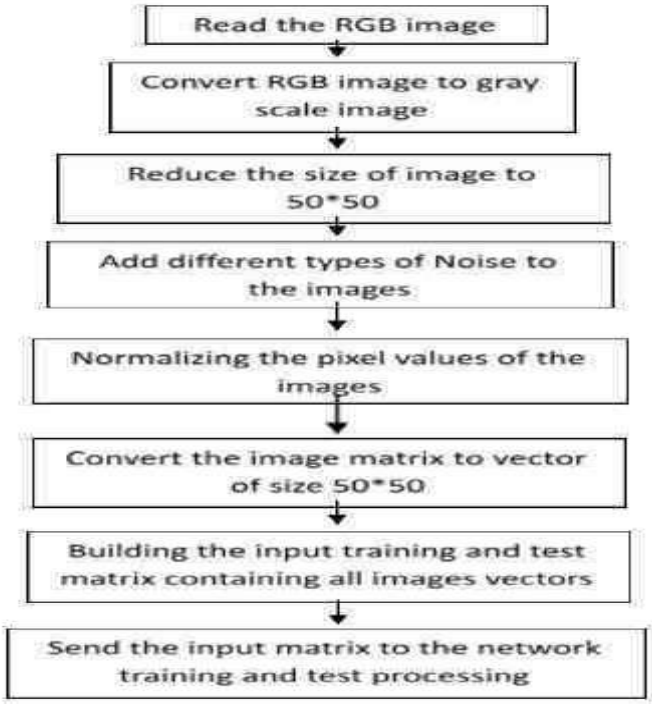


Fig 4.1: Methodology

4.3 Early Detection of Pests on Leaves

Different image processing methods were used to spot and extract the pests in the captured image by early detection and extraction system.The system then clarifies efficient methods to eradicate the threat. The procedures was used to take out of the detected things from the captured

image is easy way with using shapeless similar segmentation. After that on processed image variant texture and color features are extracted. In the end, the characteristic values are fed as input to aid Vector Machine classifier, and then permit us to truly identify the insects and leaves .This is first step an important to identification of insects to find the corresponding to solution problem, in the next time to detect the different kinds of insects a single advanced method.

Fig 4.2: Image Input and Grey scale

4.4 Plant diseases analysis and its symptoms

4.4.1 Bacterial disease symptoms

The diseases is depicted very small pale green spots early come into view as water soaked. The lesions become bigger after that seem like dry dead spots,e.g. Bacterial leaf spot have black water-soaked and brown spots on the leaves.

Fig 4.3: Bacterial leaf spot

4.4.2 Viral Disease Symptoms

Viruses are not easy to diagnose between all plant leaf diseases. In agricultural product viruses no revealing signs can be reacting quickly see and frequent readily not understand nourishing inadequacy and herbicide act of injuring. Leafhoppers, aphids,

whiteflies, cucumber beetles and whiteflies pests are often carries disease example Mosaic Virus, as appear yellow, green stripes other spots on leaves. in the following figure 4.9. Leaves might be curled, growth, wrinkled and stunted.

Fig 4.4: mosaic viruses

4.3.3 Fungal Disease Symptoms

In all plant leaf disease, Fungal reasoned with fungus some of them in show figure below Late blight reasoned by the fungus Phytophthora infesters. First seems over very small, older leaves as water-soaked, gray-green spots. At what time fungal disease, grow up make darker in color. This spots become dark and after that fungal increase forms on the underneath. Early blight is reasoned by the fungus Alternaria solani display in figure. First, seems over very small, older leaves like small brown spots with concentric rings that form a bull's eye model. At what time disease grows up, it propagates outside on the leaf surface

reasoning leaf to turn yellow. In downy mildew yellow to white patches on the upper surfaces of older leaves occurs. These areas are covered with white to grayish on the undersides.

5.EXPERIMENTAL ANALYSIS

5.Experimental Analysis

5.1 UML Diagrams

UML (Unified Modeling Language) is a standard vernacular for choosing, envisioning, making, and specifying the collectibles of programming structures. UML is a pictorial vernacular used to make programming blue prints. It is in like way used to exhibit non programming structures similarly like process stream in a gathering unit and so forth.

5.1.1 Use Case Diagram

The use case graph is for demonstrating the direct of the structure. This chart contains the course of action of use cases, performing pros and their relationship. This chart might be utilized to address the static perspective of the structure.

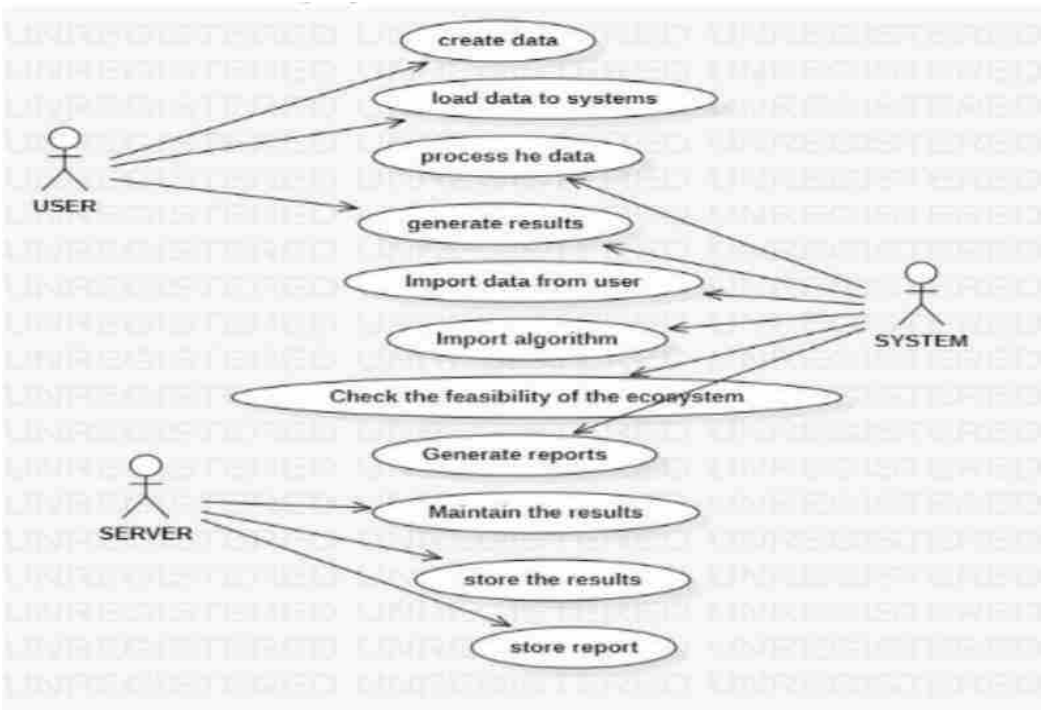


Fig 5.1 Use Case Diagram Of User, Server & System

5.1.2 Class Diagram

The class graph is the most normally pulled in layout UML. It addresses the static course of action perspective of the structure. It solidifies the strategy of classes, interfaces, joint attempts and their affiliations.

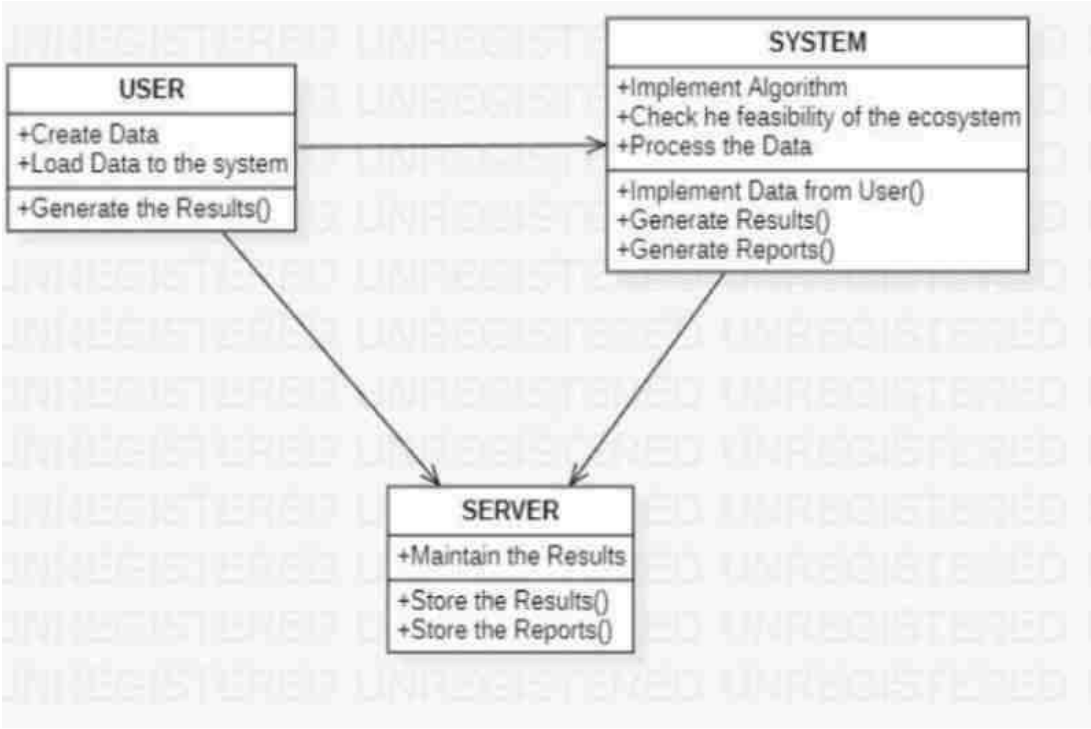


Fig 5.2 Class Diagram Of User, Server & System

In the above class diagram, the relationship that is the dependence between each one of the classes is sketched out. Additionally, even the operations performed in each and every class is similarly appeared.

5.1.3 Sequence Diagram

This is a cooperation design which tends to the time requesting of messages. It includes set of parts and the messages sent and gotten by the instance of parts. This chart is utilized to address the dynamic perspective of the structure.

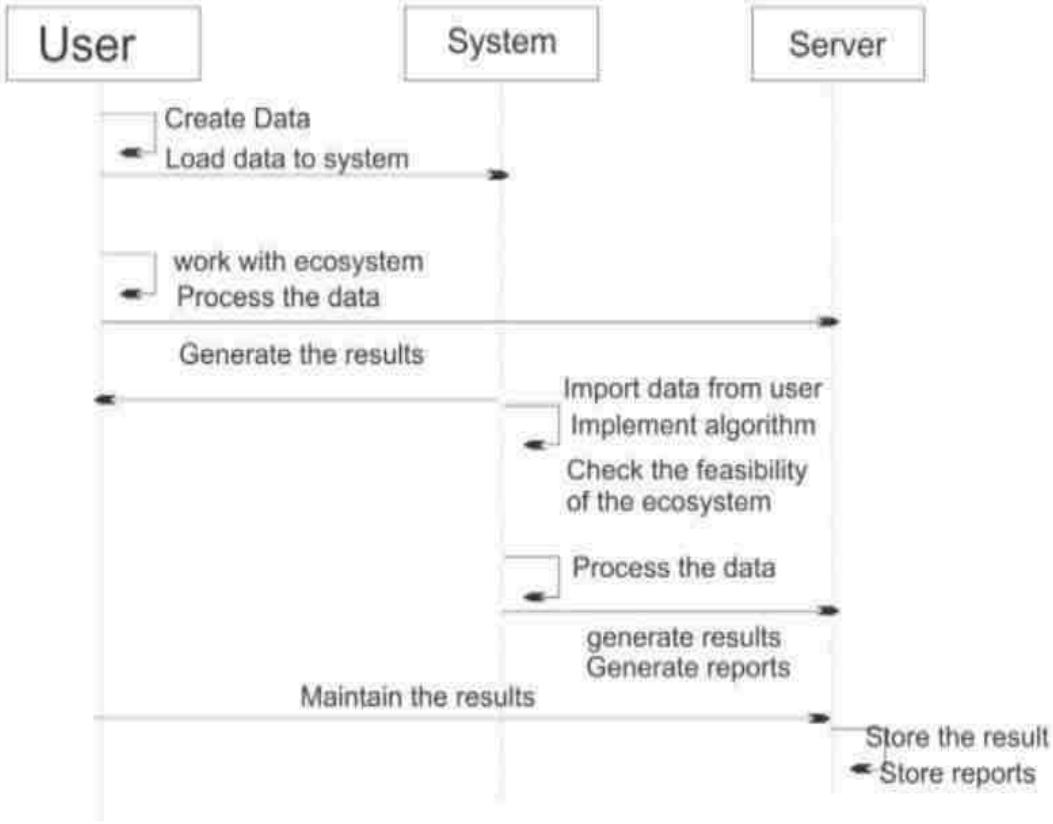


Fig 5.3 : Sequence Diagram Of User, Server & System

5.1.4 Activity Diagram

The state graph contains the game-plan of states, occasions and exercises. This graph is noteworthy for tending to the lead of the interface, class and made effort. The key centralization of state outline is to show the occasion sort out lead of the request. The state follows diagram the dynamic perspective of the framework.

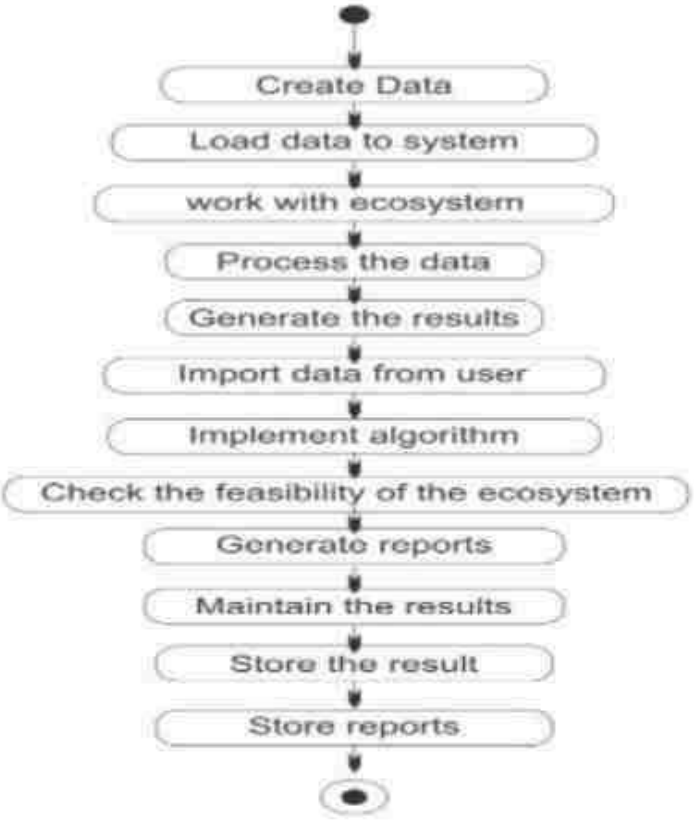


Fig 5.4 : Activity Diagram

5.2 Architecture

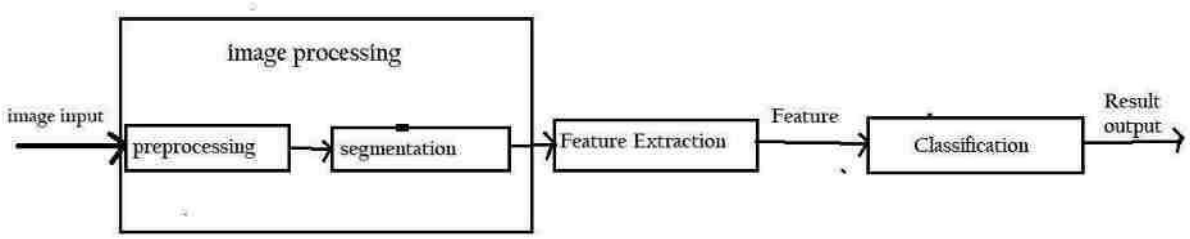


Fig 5.5 : Block Diagram

5.3 Training Process

After many trials using different training parameters, the best parameters of the neural networks were found and the back-propagation (for the training Gradient Descent with momentum and adaptive learning method was used) process was started with following parameters.

Number of input neurons	2500
Number of neurons for the first hidden layer	200
Number of neurons for the second hidden layer	240
Number of output neurons	27
Learning rate	0.05
Momentum factor	0.9
Error tolerance	1e-4
Minimum performance gradient	1e-5
Training time	169 second
Max Epochs	1500 (reached)
Target error	$5*10^{-7}$

Table 5.1: Training parameters of the ANN used for the first experiment.

The ANN architecture that was used can be seen. For the hidden layers logsig transfer functions are used whereas for the output layer linear transfer function is used for better resolution of the output values.

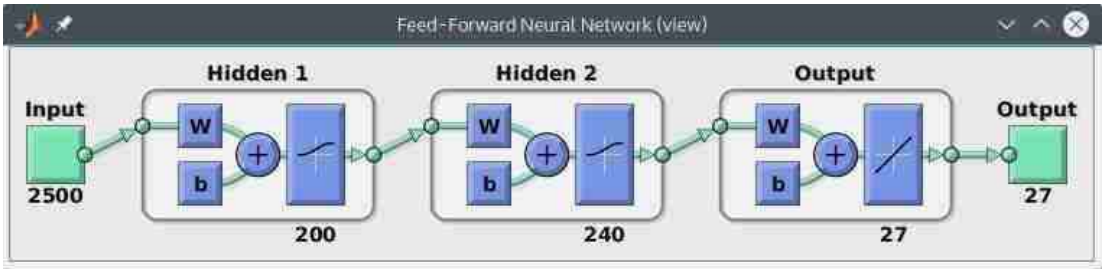


Fig 5.6:Curve of the MSE during the training.

A recognition ratio of 100% was obtained during the training and no images were misrecognized. The fact that the error goal was very small ameliorates the results during the training process.

After the end of training, single repetition test was applied to check the ability of trained network to recognize other than the training sequence. The test was applied with three different groups of original images with different noise parameters. Each sequence contains 4 leaf images of each of the 27 trees. Table 5.2 displays the testing results of the Level I, Level II and Level III comparatively.

Level I	Level II	Level III
97.2%	91.7%	79.6%

Table 5.2:Overall results for the Level I, II and III.

6.DISCUSSION OF RESULTS

6.Discussion Of Results

6.1 Sample Code

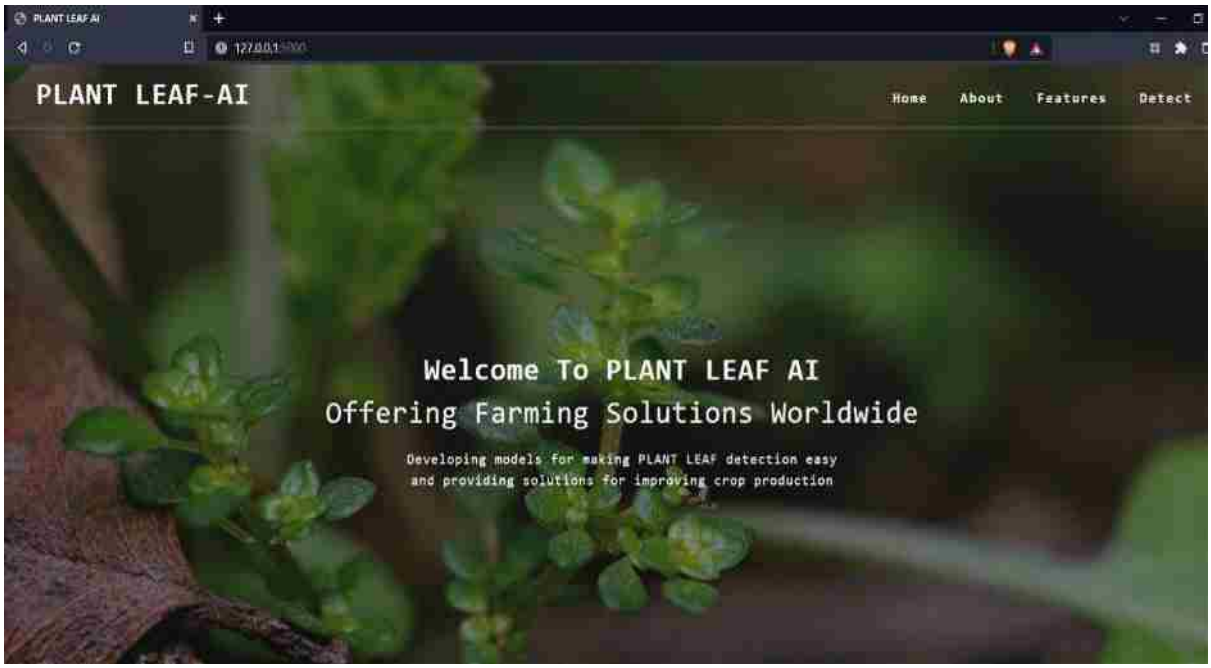
```
from jinja2 import Environment, FileSystemLoader

Import numpy as np

Import os, re, glob, sys

From tensorflow.keras.models import load_model from

tensorflow.keras.preprocessing import imageq from

werkzeug.utils import secure_filename Import time

import cv2 app = Flask(__name__) model =

load_model('Models/model.h5')

#model.make_prediction() def model_predict(img_path,

model):    start = time.time()     print(img_path)    img =

image.load_img(img_path, target_size=(224, 224))

  print(f'load_image took {time.time()-start}')
# Preprocessing the image     x

= image.img_to_array(img)

# x = np.true_divide(x, 255)

## Scaling

X=x/255 x = np.expand_dims(x,
axis=0) Print(f'x took
{time.time()-start}')
```

```
# Be careful how your trained model deals with the input #

otherwise, it won't make correct prediction! # x =

preprocess_input(x)    preds = model.predict(x)

#model.make_predict_function   print(f'model   predict

took {time.time()-start}')

Preds=np.argmax(preds,        axis=1)

   if preds==0:

           preds="Aloe_Vera"
elifpreds==1: preds="Amla“

elifpreds==2:

preds="Ashoka” elif

preds==3:

preds="Ashwagandha"    elif

preds==4:

        preds="Bael" elif preds

 == 5: preds = "Cinnamon"

 elif preds

 == 6:
       preds  =  "Henna"  elif

preds == 7: preds =
```

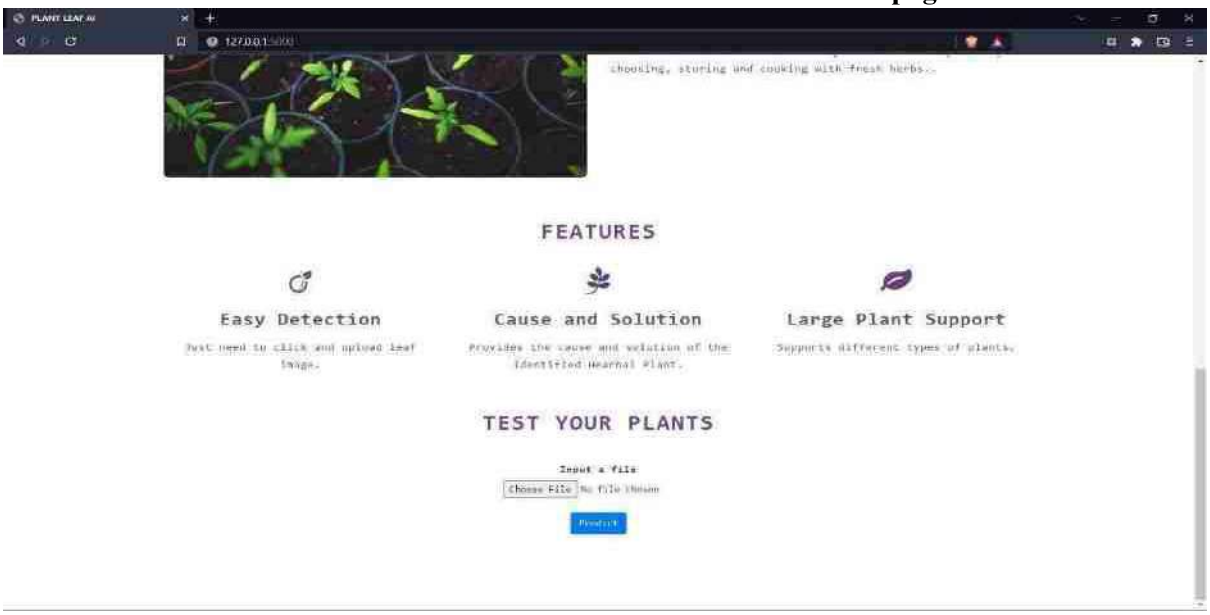
```
"Lavender" elif preds == 8:

preds = "Marigold" elif

preds == 9:

      preds = "Neem" elif

preds == 10: preds =

"Peppermint" elif preds ==

11: preds = "Tulsi" elif preds

=12:

  preds"Turmeric"

            else:

                  preds="Invaild“

#time.sleep(1)         end = time.time()         print(f"Runtime

model of the program is {end - start}")

  return preds


 start = time.time()    time.sleep(1)    end = time.time()

print(f"Runtime home of the program is {end start}")

return render_template('index.html’) @app.route('/predict',

methods=['GET', 'POST’])


def predict():                    if
```

```
request.method == 'POST':

    # Get the file from post request f = request.files['file']            # Save

the file to ./uploads start = time.time() basepath =

os.path.dirname(__file__)            file_path = os.path.join( basepath,

'uploads', secure_filename(f.filename))

f.save(file_path)

     print(f'saving file took {time.time()-start}')
                                    preds =

model_predict(file_path, model)

result=preds            #time.sleep(1)            end =

time.time()            print(f"Runtime predict of the program

is {end - start}")            return

render_template('display.html',result= result)
```

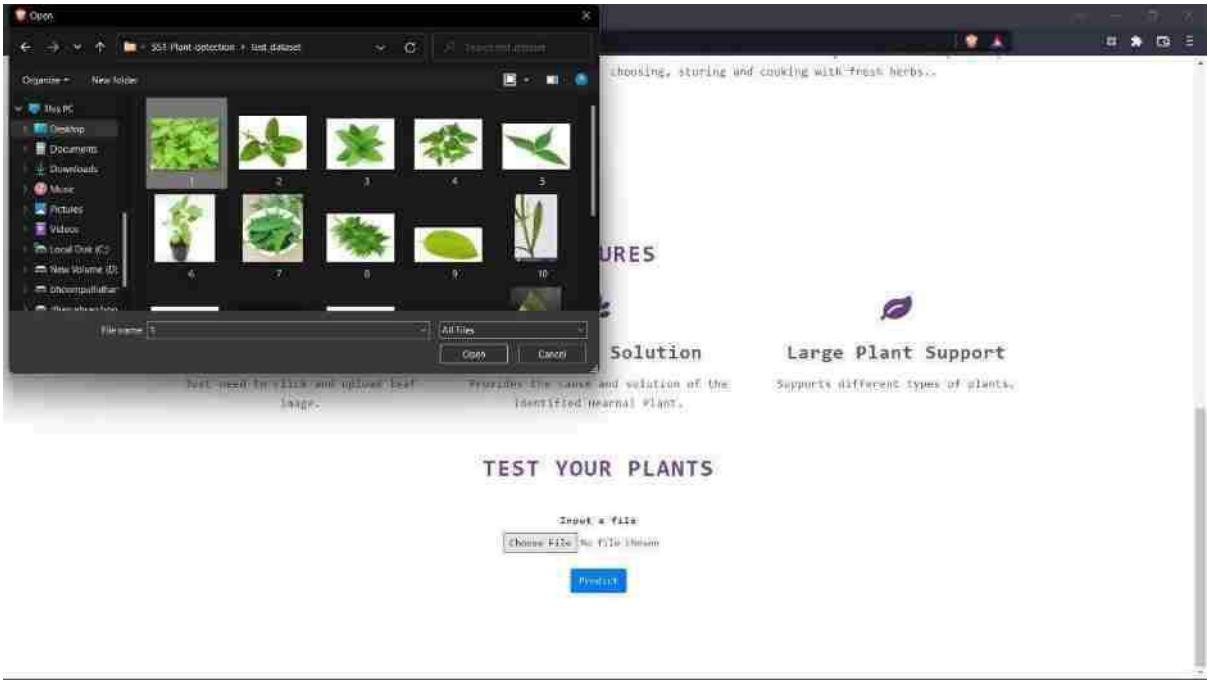
6.2 Results



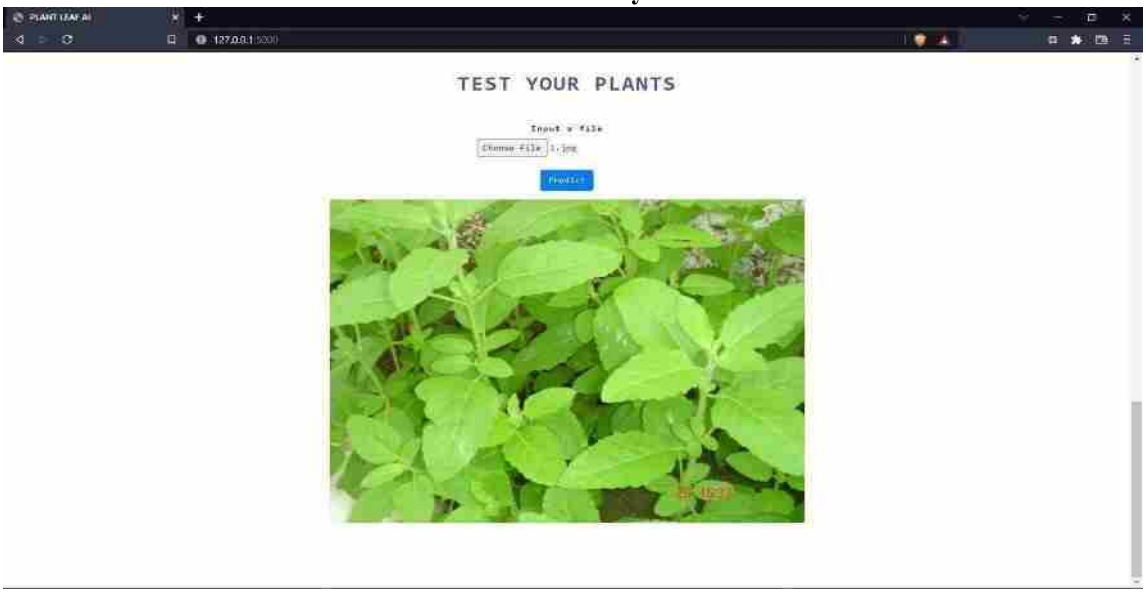
Screenshot 6.1 : Plant Leaf detection welcome page



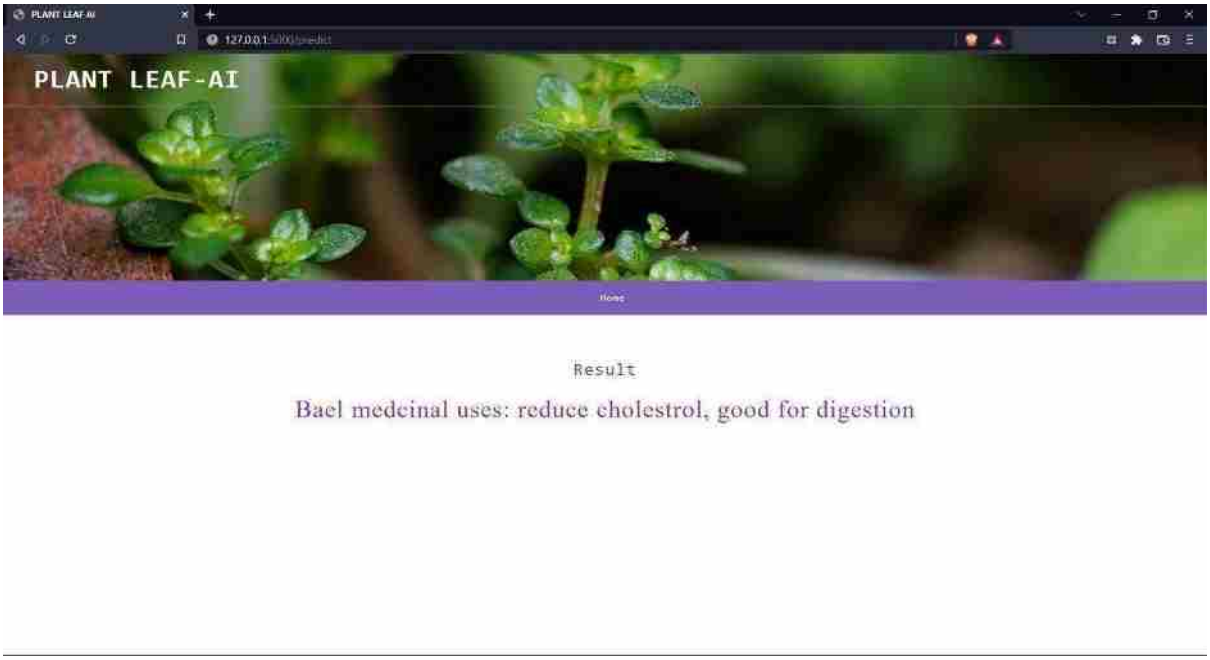
Screenshot 6.2 : Features of Detection



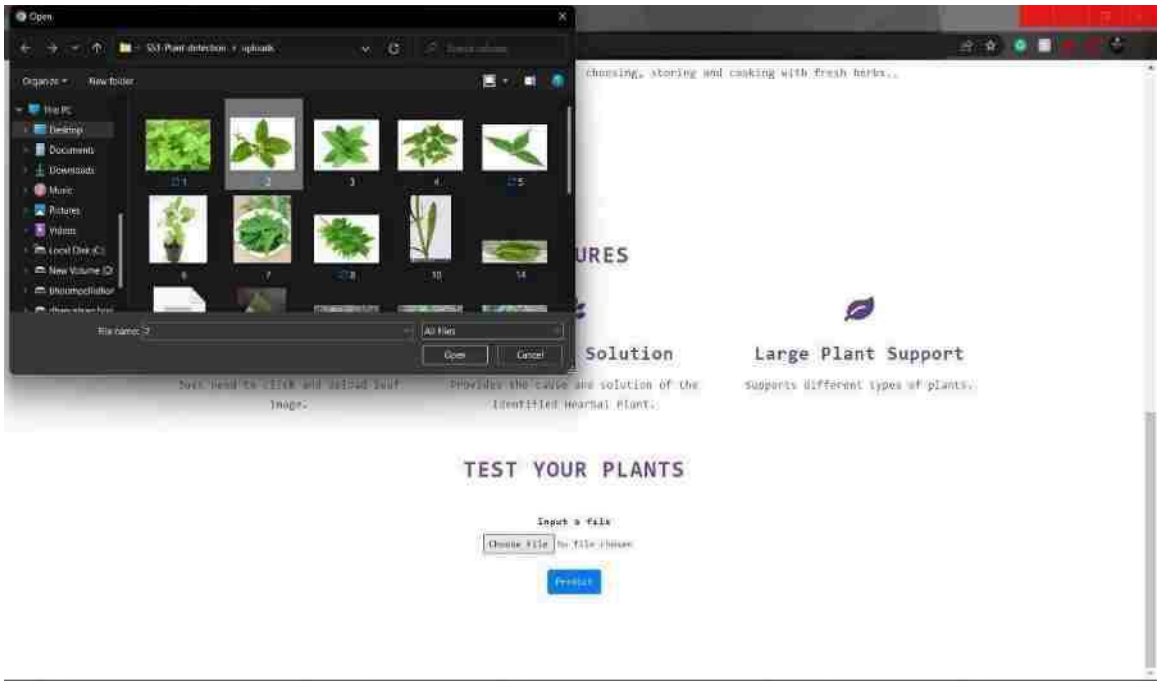
Screenshot 6.3: Test your Plants



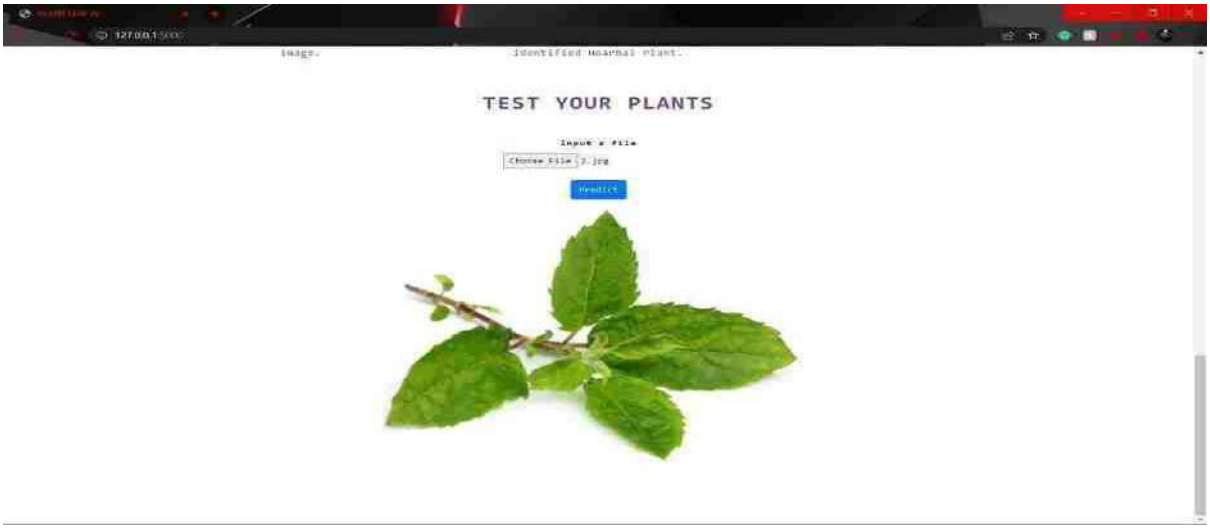
Screenshot 6.4 : Leaf image 1



Screenshot 6.5 : Result 1

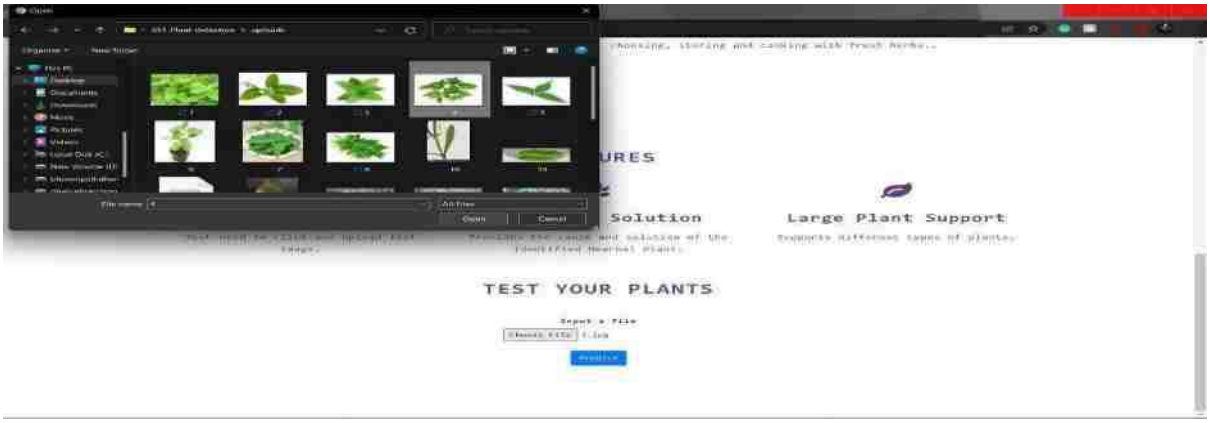


Screenshot 6.6: Testing of plant 2

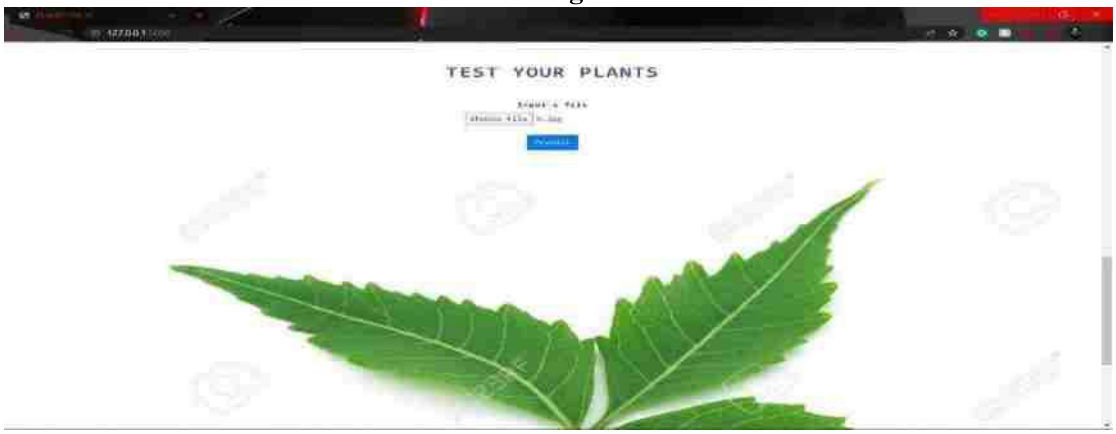


Screenshot 6.7: Leaf image 2

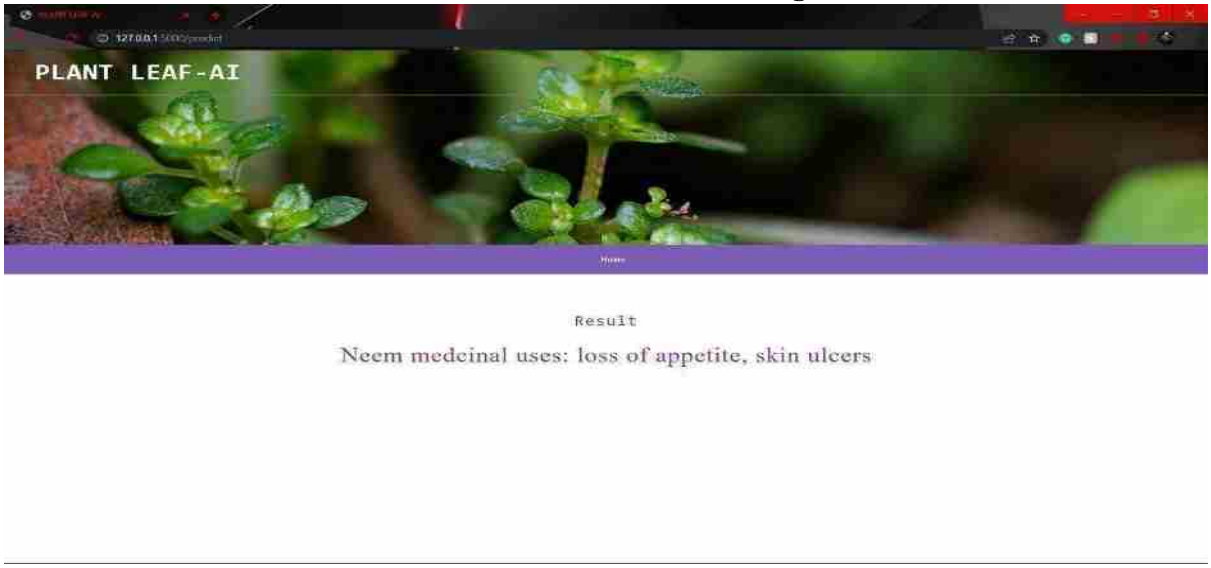
Screenshot 6.8 : Result 2



Screenshot 6.9:Testing of Plant 3



Screenshot 6.10:Leaf image 3



Screenshot 6.11 : Result 3

7.CONCLUSION & FUTURE ENHANCEMENT

7.Conclusion & Future Enhancement

7.1 Conclusion

Leaves recognition has been discussed in different scientific papers and researches. It can contribute strongly in the science of plants classification. This work has been carried out in the goal of introduction of leaves identification or classification using ANNs. The neural networks have proved their ability to give high efficiency in different applications. A leaf recognition process must discuss two basic points; the fundamental of the most important special features of the leaf, and the recognition of these leaves or the classification of them. In neural networks, the networks tries to classify the sets of leaves based on their color concentration without doing any mathematical or statistical studies. From the experiments carried out in this thesis and the results obtained we conclude that the use of the neural network for leave recognition and plants classification was successful. The application of different noise on the leaves' images has led to different recognition rates. Different experiments including training and test of networks have been carried out in this work. In the training process 9 set of images were prepared and fed to the neural network. The process of back propagation has been started until an acceptable error was achieved.These groups were divided into Level I, II, and III containing 4 sets of images each. These three groups were then fed to the network and their results were obtained. 100% out of the 243 training images were recognized correctly; whereas 104/108 images were recognized from the first group of images. That shows that the recognition rate was 97.2%. In the Level II group, 99 images out of 108 were recognized rightly with a rate of 91.7% which seems to be perfect under the high noise conditions. In the test of the Level III, the system was unable to recognize 22 images

out of 108 images contained in the set. The recognition ratio was 79.6% in this experiment, which is considered very high under high noise ratio parameters of images.

8.REFERENCES

8.References

[1] HARPER D., "Taxonomy". *Online Etymology Dictionary*. Retrieved April 18, 2011. Lecture notes, URL=< http://speedyfacts101.webs.com/taxonomy.htm>.

[2] RUSSELL S. J., NORVIG P., *CNNIntelligence: A Modern Approach*, 3rd ed 2009.

[3] KASK K., (2015 July). *CompSci 271: Introduction to CNNIntelligence, Fall 2014, lecture notes*, URL=<http://www.ics.uci.edu/~kkask/Fall2014 CS271/slides/01-intro-class.pdf >.

[4] Expert system.*Collins English Dictionary - Complete & Unabridged 10th Edition*. Retrieved July 26, 2015, URL=<http://dictionary.reference.com/browse/expert system>.

[5] GREGORY J. E. R.*, Foundations of genetic algorithms,* URL=< http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/hmw/article1.html>.

[6] ZADEH L. A., *Fuzzy logic and the calculus of fuzzy if-then rules*, in Proc. 22nd Intl. Symposium on Multiple-Valued Logic, Los Alamitos, IEEE Computer Society Press, 1992.

[7] Wikipedia contributors, *Fuzzy logic*, Wikipedia, The Free Encyclopedia*,* https://en.wikipedia.org/w/index.php?title=Fuzzy_logic&oldid=671385708 (accessed July, 2015).

[8] SCHUMANN J.*,* LIU Y.*,* (*Eds*.), Applications *of Neural Networks in High Assurance Systems*, vol. 268, 2009.

[9] STERGIO C., SIGANOS D., *Neural Networks*. URL=<http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/cs11/report.html>.

[10] NICI S., CUMMINS F., (2015 July), *Genevieve Orr: Neural networks, Fall 99, lecture notes,*

URL=<http://www.willamette.edu/~gorr/classes/cs449/intro.html>. [11] JACOBSON L., (2014, March), Introduction to CNNNeural Networks Part 2 Learning,

URL=<http://www.theprojectspot.com/tutorial-post/introduction-toartificialneural-networks-part-2-learning/8>.

[12] KADIR A., NUGROHO L.E., SUSANTO A., SANTOSA P.I., Foliage Plant Identification,International Journal of Computer Applications, Vol. 29, No 9 2011, 15-20.

[13] AMLEKAR M., MANZA R.R., YANNAWAR P., GAIWAD A.T., Leaf Features Based Plant Classification Using CNNNeural Network,

IBMRD's

Journal of Management and Research, Vol 3, No 1 2014,224-232.

[14] ARIVAHAGAN S., NEWLIN S. R., ANANTHI S., VISHNU V.S., Detection of unhealthy region of plant leaves and classification of plant leaf disease using texture features. Agric Eng Int: CIGR Journal,Vol.15 , No 1 2013, 211-217.

[15] KHAIRNAR K., DAGADE R., Disease Detection and Diagnosis on Plant using

Image Processing-A Review, International Journal of Computer Applications, Vol 108, No 13 2014,36-38.

[16] MANOJA M., RAJALAKSHMI J., Early Detection of Pests on Leaves Using Support Vector Machine, International Journal of Electronics Research Applications, Vol 2, No 4 2014, 187-193.

[17] WU S. G., FORREST S. B., XU E. Y., WANG Y. X., CHANG Y. F., XIANG Q. L., Leaf Recognition Algorithm For Plant Classification Using Probabilistic Neural Network, IEEE International Symposium On Signal Processing And Information

Technology, 2007.

[18] SHITALA P., KRISHNA M. K., TRIPATHI R. C., Relative sub-image based features for leaf recognition using support vector machine. In Proceedings of the 2011

International Conference on Communication, Computing & Security (ICCCS '11), 2011, 343-346.

[19] COPE J. S., REMAGNINO P., BARMAN S., WILKIN P., Plant texture classification using gabor co-occurrences," in Proceedings of the 6th international conference on Advances in visual computing, 2, 2010, 669– 677.