DESIGN AND DEVELOPMENT OF END-TO-END DEEP LEARNING-BASED WEB APPLICATION FOR CROP DISEASE IDENTIFICATION AND TREATMENT

A

MINOR PROJECT-I

Submitted in partial fulfillment of the requirements for the degree of

BACHELORS OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING

By

GROUP NO. 08

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June-Dec 2022

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Bhopal (M.P.)
Approved by AICTE, New Delhi & Govt. of M.P.
Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P)

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December-2022

CERTIFICATE

We hereby certify that the work which is being presented in the B.Tech. Minor Project-I Report entitled design and development of end-to-end deep learning-based web application for crop disease identification and treatment **,** in partial fulfillment of the requirements for the award of the degree of ***Bachelor of Technology*** in ***Computer Science & Engineering*** and submitted to the Department of Computer Science & Engineering, *Sagar Institute of Science & Technology (SISTec)***,** Bhopal (M.P.) is an authentic record of my own work carried out during the period from Jul-2022 to Dec-2022 under the supervision of **Prof. Rahul Dubey.** The content presented in this project has not been submitted by me for the award of any other degree elsewhere.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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Prof. Rahul Dubey	**Prof. Rahul Dubey**	**Dr. Keshavendra Choudhary**
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ABSTRACT

Image recognition is considered to be a prominent feature of deep learning. Deep learning is very effective and constructive in Image recognition . Deep learning is a machine learning technique that focuses on teaching machines to learn by example. Since most deep learning methods use neural network architectures, deep learning models are frequently called deep neural networks. Image recognition is one of the tasks in which deep neural networks (DNNs) excel. This project is based on deep learning model for disease identification on the agricultural data set.The model detects the features of the image and maps it with health information of products by deep learning models which develop through the transfer learning approach. In this project comparative study of image, detection has been done using different models of transfer learning which are DenseNet, and MobileNet, resNet, xception, VGG19, with the effective use of dropout and optimizer to enhance the capability of the model.

The data set used is an agricultural data set that consists of plant leaves, fruits, and vegetable Images of Apple scab, Apple Black rot ,Apple healthy ,Corn (maize) ,Common rust , Corn_(maize) Northern Leaf Blight , Corn (maize) healthy ,Grape Black rot , Grape Esca(Black Measles) , Grape healthy , Potato Early blight , Potato Late blight , Potato healthy , Tomato Bacterial spot , Tomato Septoria leaf spot , Tomato healthy with the help of this project a machine can detect the disease in the product and with reference suggests suitable fertilizer and medicine. which directly helps to farmers to increase their production by reducing diseases and other problems in the plant by self-diagnose thought this web application.

ACKNOWLEGMENT

We would like to express our sincere gratitude to several individuals and our college for supporting us throughout our project . First, We wish to express my sincere gratitude to Our guide, Prof. Rahul Dubeyfor his enthusiasm, patience, insightful comments, helpful information, practical advice and unceasing ideas that have helped us tremendously at all times in our research. He has a hands-on experience at graduate, post-graduate & doctorate level education facilities. He has sound knowledge of the area of expertise and is proficient in the field of computer networks and advanced networking technologies. He has published several research papers in reputed journals and conferences and participated in various workshops/FDP/seminars. He is associated with prominent professional societies/associations like IEEE, IET, and IAENG, and serves as an active reviewer in various reputed journals. His teaching and research interests include computer networks, wireless networks, mobile computing, ad hoc and sensor network, dynamic spectrum access, cognitive radio networks, and computer and network security. Without his support and guidance, this project would not have been possible. We could not have imagined having a better supervisor in my study. We also wish to express my sincere thanks to the Sagar Institute of Science & Technology for giving us this opportunity. We are grateful and lucky enough to receive consistent motivation, assistance, and advice from all the faculties of the Department of Computer Science who have helped us to complete our project work.

We would also like to extend our heartfelt respects to the entire Department of Computer Science for their timely assistance.

We would like to express our sincere thanks to Dr. Swati Saxena, Vice Principal, SISTec,

Gandhi Nagar, Bhopal for giving us an opportunity to undertake this project.

We also wish to express our gratitude to Prof. Rahul Dubey Head, Department of Computer

Science and Engineering, for his kind-hearted support.

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LIST OF ABBREVIATIONS

ACRONYM	FULL FORM
SDLC	Software Development Life Cycle
SQL	Structured Query Language
HTML	Hyper Text Markup Language
UML	Unified Modeling Language
DL	Deep learning
ML	Machine learning
CSS	Cascading style sheet

CHAPTER-1
INTRODUCTION

1.1 About Project

Modern technologies have given human society the ability to produce enough food to meet the demand of more than 7 billion people. However, food security remains threatened by a number of factors including climate change ,the decline in pollinators, plant diseases and others. Plant diseases are not only a threat to food security at the global scale, but can also have disastrous consequences for smallholder farmers whose livelihoods depend on healthy crops. In the developing world, more than 80 percent of the agricultural production is generated by smallholder farmers and reports of yield loss of more than 50% due to pests and diseases are common Furthermore, the largest fraction of hungry people i.e 50% live in smallholder farming households making smallholder farmers a group that's particularly vulnerable to pathogen-derived disruptions in food supply.

Various efforts have been developed to prevent crop loss due to diseases. Historical approaches of widespread application of pesticides have in the past decade increasingly been supplemented by integrated pest management approaches .Independent of the approach, identifying a disease correctly when it first appears is a crucial step for efficient disease management. Historically, disease identification has been supported by agricultural extension organizations or other institutions, such as local plant clinics. In more recent times, such efforts have additionally been supported by providing information for disease diagnosis online, leveraging the increasing Internet penetration worldwide. Even more recently, tools based on mobile phones have proliferated, taking advantage of the historically unparalleled rapid uptake of mobile phone technology in all parts of the world .

Smartphones in particular offer very novel approaches to help identify diseases because of their computing power, high-resolution displays, and extensive built-in sets of accessories, such as advanced HD cameras.

Here, we demonstrate the technical feasibility using a deep learning approach utilizing 22,500 images of 5 crop species (Apple , Grape, Corn , Potato and Tomato) with 15 categories (2 diseases and 1 healthy for each species) present in Plant Village dataset.

Deep learning constitutes a recent, modern technique for image processing and data analysis, with promising results and large potential. As deep learning has been successfully applied in various domains, it has recently entered also the domain of agriculture.

Smart farming is important for tackling the challenges of agricultural production in terms of productivity, environmental impact, food security and sustainability

As the global population has been continuously increasing ,a large increase on food production must be achieved ,maintaining at the same time availability and high nutritional quality across the globe, protecting the natural ecosystems by using sustainable farming procedures.

To address these challenges, the complex, multivariate and unpredictable agricultural ecosystems need to be better understood by monitoring, measuring and analyzing continuously various physical aspects and phenomena.

DL architectures started to evolve with the passage of time, researchers applied them to image recognition and classification. These architectures have also been implemented for different agricultural applications.

Our web application provides a platform where farmers can upload images of infected plants, leaves, or fruit. Our deep learning neural model will Identify the disease by feature extraction and then provide an effective solution in terms of medicine, methods, pesticide, and fertilizer, with a description.

1.1 PROJECT OBJECTIVE

The objective is to provide a convenient facility to farmers which enables them to self-diagnose their crops and get effective solution for the problem.

- Diagnose crop
- Disease treatment and control
- Provides quick access and affordable.
- The system saves time and reduces human efforts.

CHAPTER-2
PROBLEM DEFINITION AND ALGORITHM

2.1 LITERATURE SURVEY

One of the major challenges to humankind is threat to food security due to emerging and invasive pests. Increased global trade in agriculture has increased the chances of the introduction of exotic pests.

India’s farmers are hard at work. Not only do they help to feed a nation that contains 1.3 billion people – one fifth of the world . However, their productivity is threatened by pests that can ruin their crops and their livelihoods. Here’s a glimpse of how plant science is helping reduce the threat.

According to a study by the Associated Chambers of Commerce and Industry of India, annual crop losses due to pests and diseases amount to Rs.50,000 crore ($500 billion), which is significant in a country where at least 200 million Indians go to bed hungry every night. The value of plant science is therefore huge.

- India is a country in which around 60% of the population is in rural area and 20% of our GDP share is in agriculture and the primary sector .
- In Indian Agriculture Crop disease is a significant factor causing a threat to food security.
- According to estimates, Indian farmers suffers an annual loss of Rs 50,000 Crores due to pest attack and crop diseases every year.
- According to reports internet users are increased by 45% and still have bright scope.
- Software provides a diagnosis and treatment facility that can reduce such losses.

2.2 Problem Definition and Algorithm

2.2.1 Problem Definition

Crop disease is a significant factor ,causing a threat to food security. According to estimates, Indian farmers suffers an annual loss of Rs 50,000 Crores due to pest attack and crop diseases every year.

Due to a lack of infrastructure farmers are not able to identify crop diseases in the early stages, which also affects the overall yield of the crops.

This complication in agriculture Leads to reduction in quality and quantity, price rise, shortages, etc.

If crop disease is identified in the early stages, then these complications can be reduced and led to sustainable agriculture.

2.2.2 Algorithm

The Deep learning algorithm we are using is **Convolutional Neural Networks (CNN).** A convolutional neural network (CNN/ConvNet) is a class of deep neural networks, most commonly applied to analyze visual imagery. Now when we think of a neural network we think about matrix multiplications but that is not the case with ConvNet. It uses a special technique called Convolution. Now in mathematics convolution is a mathematical operation on two functions that produces a third function that expresses how the shape of one is modified by the other.

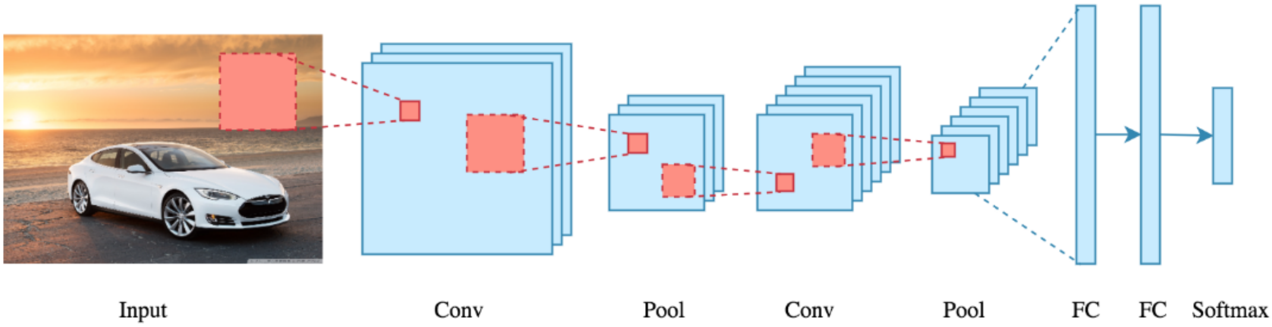
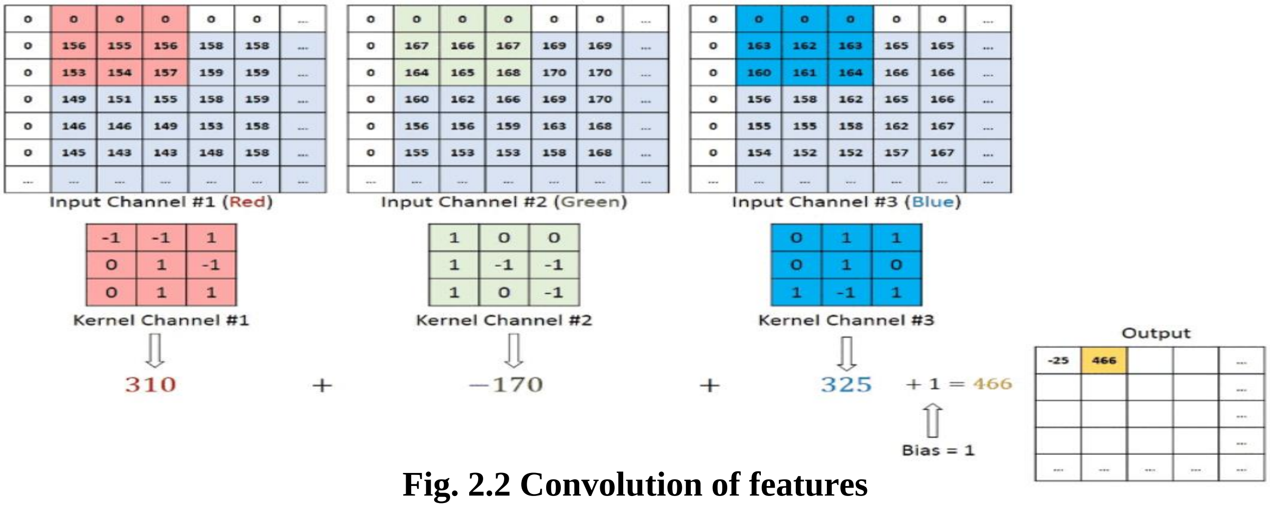


Fig. 2.1 Convolutional Neural Networks (CNN)

An RGB image is nothing but a matrix of pixel values having three planes whereas a grayscale image is the same but it has a single plane. Convolutional neural networks are composed of multiple layers of artificial neurons. Artificial neurons, a rough imitation of their biological counterparts, are mathematical functions that calculate the weighted sum of multiple inputs and outputs an activation value. When you input an image in a ConvNet, each layer generates several activation functions that are passed on to the next layer.



0	0	0	0	0	0	...
0	156	155	156	158	158	...
0	153	154	157	159	159	...
0	149	151	155	158	159	...
0	146	146	149	153	158	...
0	145	143	143	148	158	...
...	...	...	...	...	...	...

Input Channel #1 (Red)

0	0	0	0	0	0	...
0	167	166	167	169	169	...
0	164	165	168	170	170	...
0	160	162	166	169	170	...
0	156	156	159	163	168	...
0	155	153	153	158	168	...
...	...	...	...	...	...	...

Input Channel #2 (Green)

0	0	0	0	0	0	...
0	163	162	163	165	165	...
0	160	161	164	166	166	...
0	156	158	162	165	166	...
0	155	155	158	162	167	...
0	154	152	152	157	167	...
...	...	...	...	...	...	...

Input Channel #3 (Blue)

-1	-1	1
0	1	-1
0	1	1

Kernel Channel #1

1	0	0
1	-1	-1
1	0	-1

Kernel Channel #2

0	1	1
0	1	0
1	-1	1

Kernel Channel #3

$$310 + -170 + 325 + 1 = 466$$

Bias = 1

Output

-25	466			...
				...
				...
				...
...	...	...	...	...

Fig. 2.2 Convolution of features

The first layer usually extracts basic features such as horizontal or diagonal edges. This output is passed on to the next layer which detects more complex features such as corners or combinational edges. As we move deeper into the network it can identify even more complex features such as objects, faces, etc.

Based on the activation map of the final convolution layer, the classification layer outputs a set of confidence scores (values between 0 and 1) that specify how likely the image is to belong to a "class." For instance, if you have a ConvNet that detects cats, dogs, and horses, the output of the final layer is the possibility that the input image contains any of those animals.

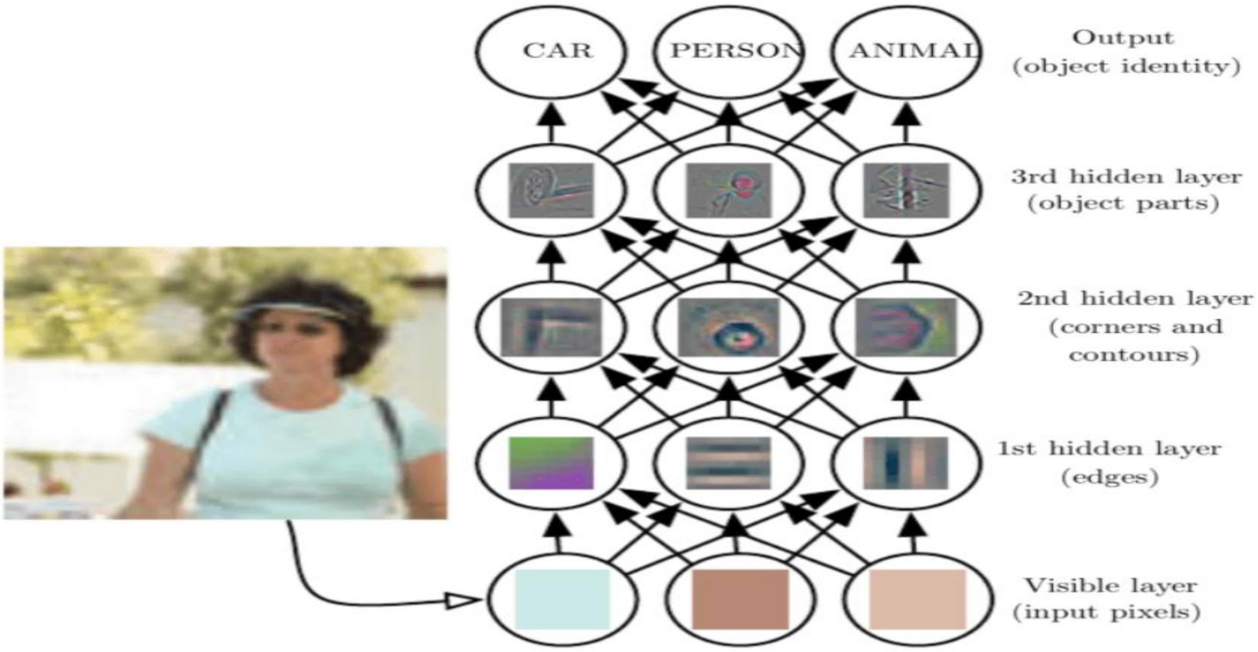


Fig. 2.3 Working of CNN

CHAPTER-3
EXPERIMENTAL EVALUATION

3.1 Methodology

Deep learning is powerful machine learning approach which have mitigated the traditional machine learning headache of feature engineering. It doesn’t need any domain expertise now and all credit goes to deep learning. The core of deep learning is artificial neural network (ANN). Artificial neural networks are mathematical models that replicate with their neurons and synapses interconnecting them the general principles of brain function .To implement neural network one of the most standard library is Tensorflow. It provides all libraries related to artificial neural network. With the help of Tensorflow one can perform classification tasks on text as well as images.

3.1.1 Dataset Description

The dataset used is Plant Village dataset which consists of 5 crop species (Apple , Grape, Corn , Potato and Tomato),these species are further classified into three categories each having 2 disease classes and 1 healthy class .So this dataset have 15 classes and a total of images (200 images for each class) in which 75% of images (150) is for Training and 25% images (50) are for Testing the model .

Categories	**No. of Images**
Apple___Apple_scab	200
Apple___Black_rot	200
Apple___healthy	200
Corn_(maize)___Common_rust_	200
Corn_(maize)___Northern_Leaf_Blight	200
Corn_(maize)___healthy	200
Grape___Black_rot	200
Grape___Esca_(Black_Measles)	200
Grape___healthy	200
Potato___Early_blight	200
Potato___Late_blight	200
Potato___healthy	200
Tomato___Bacterial_spot	200
Tomato___Septoria_leaf_spot	200
Tomato___healthy	200
Total(Images)	**3000**

Table 3.1 Dataset description

3.1.2 Preprocessing of Images

Preprocessing is applied on dataset in form of augmentation to increase size of dataset in order to achieve better accuracy. Then images size are reduced by 120x120 pixels.
After the augmentation the number of images increased to 22500 which means each category has 1500 images .
After preprocessing , dataset is divided for Training and Testing in which 75% of the images (1200) is for Training and 25% images (300) is for Testing the model.

CATEGORIES	Train (No. of images)	Test(No. of images)
Apple___Apple_scab	1200	300
Apple___Black_rot	1200	300
Apple___healthy	1200	300
Corn_(maize)___Common_rust_	1200	300
Corn_(maize)___Northern_Leaf_Blight	1200	300
Corn_(maize)___healthy	1200	300
Grape___Black_rot	1200	300
Grape___Esca_(Black_Measles)	1200	300
Grape___healthy	1200	300
Potato___Early_blight	1200	300
Potato___Late_blight	1200	300
Potato___healthy	1200	300
Tomato___Bacterial_spot	1200	300
Tomato___Septoria_leaf_spot	1200	300
Tomato___healthy	1200	300
Total(Images)	**18000**	**4500**

Table 3.2 Dataset description after Augmentation

3.1.3 Model Description

We are using Convolution Neural Network based model for our classification.

The Convolution Neural Network that we are using is **Dense Convolutional Network (Densenet).** Densenet is a pretrained **Transfer learning model** (it is a research problem in machine learning that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem). In Densenet each layer is connected with every other layer in a feed-forward fashion. They alleviate the vanishing-gradient problem, strengthen feature propagation, encourage feature reuse, and substantially reduce the number of parameters.it works on the idea that convolutional networks can be substantially deeper, more accurate, and efficient to train if they have shorter connections between layers close to the input and those close to the output .

DenseNet-201 is a convolutional neural network that is 201 layers deep. You can load a pretrained version of the network trained on more than a million images from the ImageNet database . The pretrained network can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals. As a result, the network has learned rich feature representations for a wide range of images. An output of the previous layer acts as an input of the second layer by using *composite function operation.* This composite operation consists of the convolution layer, pooling layer, batch normalization, and non-linear activation layer.

These connections mean that the network has L(L+1)/2 direct connections. L is the number of layers in the architecture.

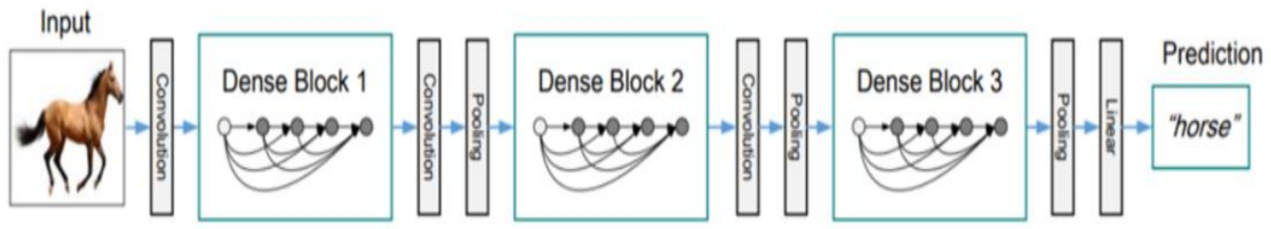
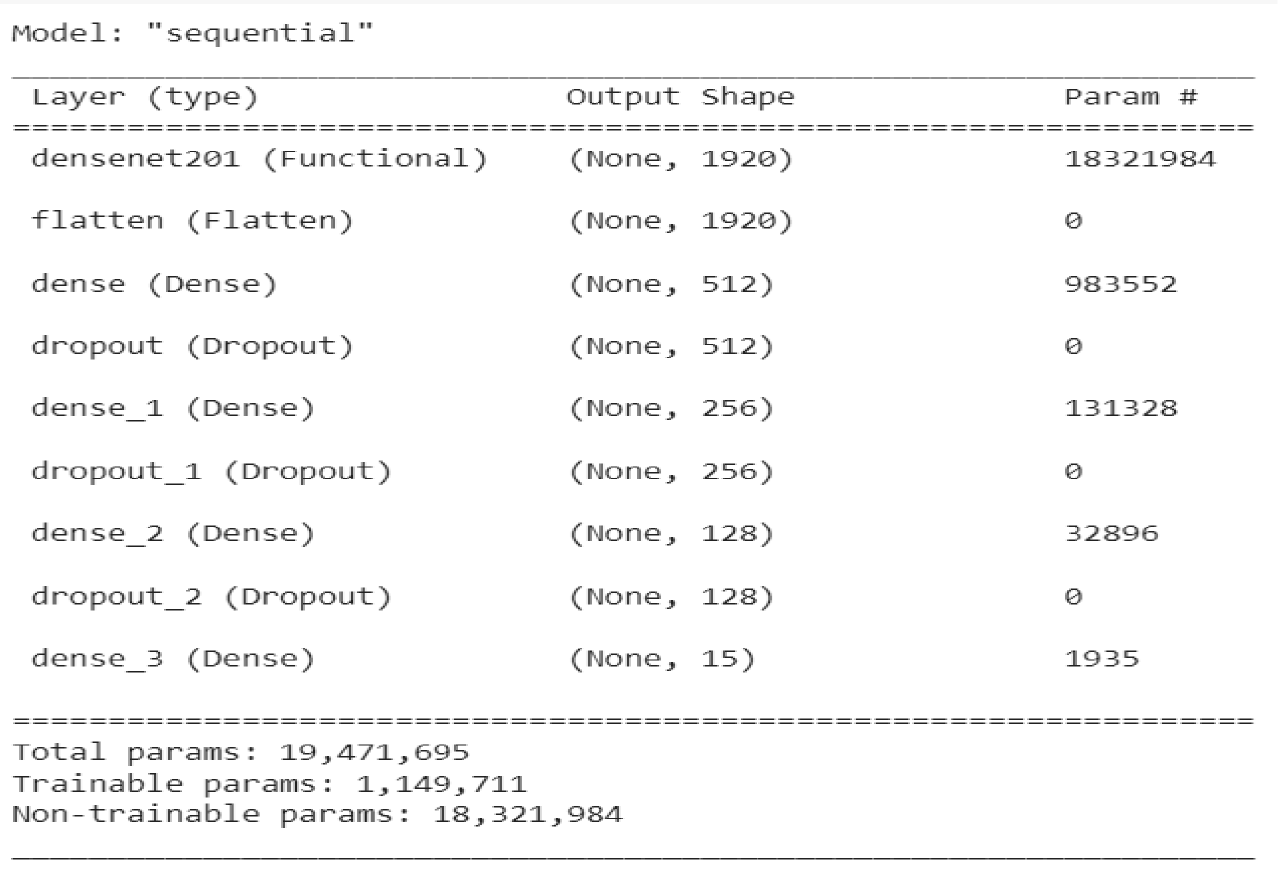


Fig.3.1 Architecture of DenseNet-201

After obtaining the pre-trained model, we add this model to a sequential layer further we add some more layers along with some dropout layer in it to increase accuracy and to make the model more regularise .



```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 densenet201 (Functional)    (None, 1920)              18321984

 flatten (Flatten)           (None, 1920)              0

 dense (Dense)               (None, 512)               983552

 dropout (Dropout)           (None, 512)               0

 dense_1 (Dense)             (None, 256)               131328

 dropout_1 (Dropout)         (None, 256)               0

 dense_2 (Dense)             (None, 128)               32896

 dropout_2 (Dropout)         (None, 128)               0

 dense_3 (Dense)             (None, 15)                1935

=================================================================
Total params: 19,471,695
Trainable params: 1,149,711
Non-trainable params: 18,321,984
_________________________________________________________________
```

Fig. 3.2 Model Summary

To create the model ,we have to compile it , for this we have set parameters like , optimizer , Loss function and Metrics .

Parameter	Value
Optimizer	adam
Loss function	sparse_categorical_cross_entropy
Metrics	accuracy

Table 3.3 Model compile parameters

Model Training

After creating the model we have train it on the training data , for this we have to set some parameters like Epochs , Batch size , Validation split .

Parameter	Value
Epochs	50
Batch Size	20
Validation split	0.2

Table 3.4 Model Training Parameters

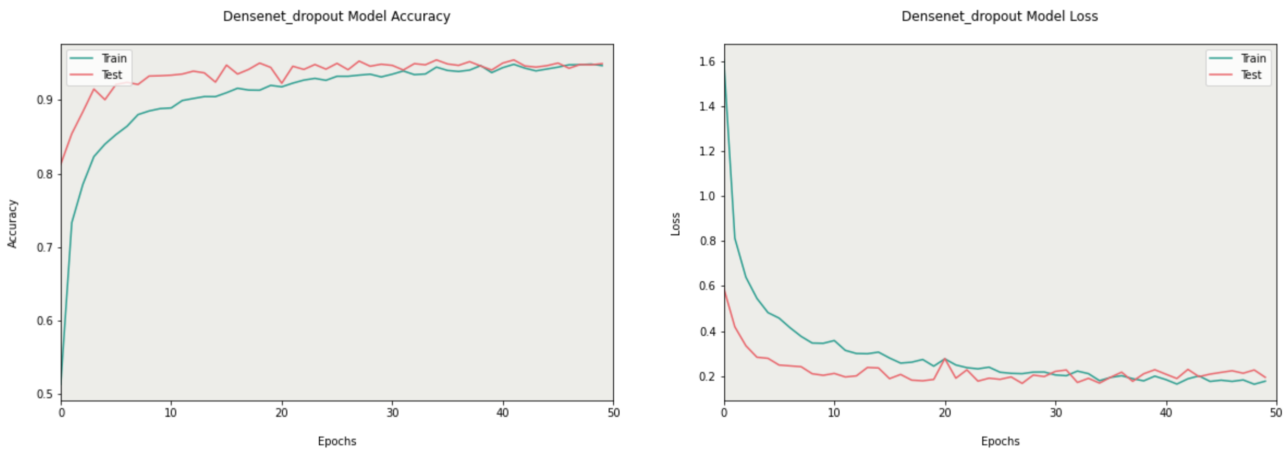


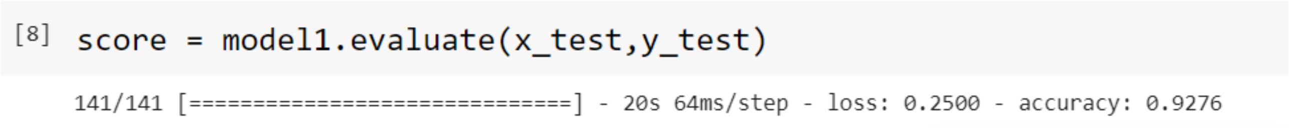
Fig.3.3 Model accuracy and loss Graph on Training data after 50 epochs

Here we can see that model is giving good accuracy on the training data with less loss . Now we have to test the model on testing data.

3.1.4 Model Testing and Evaluation

In machine learning, model testing is referred to as the process where the performance of a fully trained model is evaluated on a testing set. The testing set consisting of a set of testing samples should be separated from the both training and validation sets, but it should follow the same probability distribution as the training set.

Each testing sample has a known value of the target. Based on the comparison of the model's predicted value, y', and the known target, y , for each testing sample, the performance of the trained model can be measured.



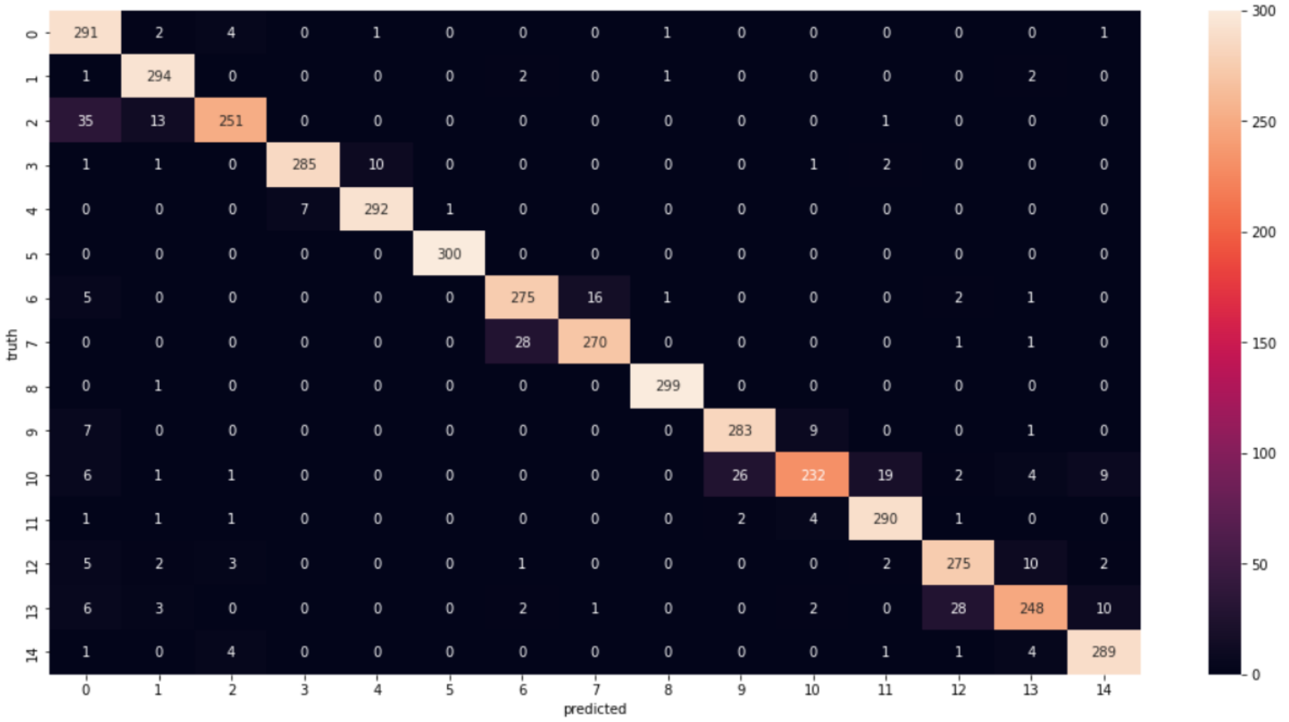
```
[8]  score = model1.evaluate(x_test,y_test)

     141/141 [==============================] - 20s 64ms/step - loss: 0.2500 - accuracy: 0.9276
```

Fig.3.4 Testing of model

Here we can see that the model is giving an accuracy of **0.9276** with a loss of **0.25 ,** which a good accuracy.

Confusion Matrix is **used to know the performance of a Machine learning classification**. It is represented in a matrix form. Confusion Matrix gives a comparison between Actual and predicted values. The confusion matrix is a N x N matrix, where N is the number of classes or outputs .



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	291	2	4	0	1	0	0	0	1	0	0	0	0	0	1
1	1	294	0	0	0	0	2	0	1	0	0	0	0	2	0
2	35	13	251	0	0	0	0	0	0	0	0	1	0	0	0
3	1	1	0	285	10	0	0	0	0	0	1	2	0	0	0
4	0	0	0	7	292	1	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	300	0	0	0	0	0	0	0	0	0
6	5	0	0	0	0	0	275	16	1	0	0	0	2	1	0
7	0	0	0	0	0	0	28	270	0	0	0	0	1	1	0
8	0	1	0	0	0	0	0	0	299	0	0	0	0	0	0
9	7	0	0	0	0	0	0	0	0	283	9	0	0	1	0
10	6	1	1	0	0	0	0	0	0	26	232	19	2	4	9
11	1	1	1	0	0	0	0	0	0	2	4	290	1	0	0
12	5	2	3	0	0	0	1	0	0	0	0	2	275	10	2
13	6	3	0	0	0	0	2	1	0	0	2	0	28	248	10
14	1	0	4	0	0	0	0	0	0	0	0	1	1	4	289

Fig.3.5 Confusion Matrix

Precision (Positive Predicted Value)

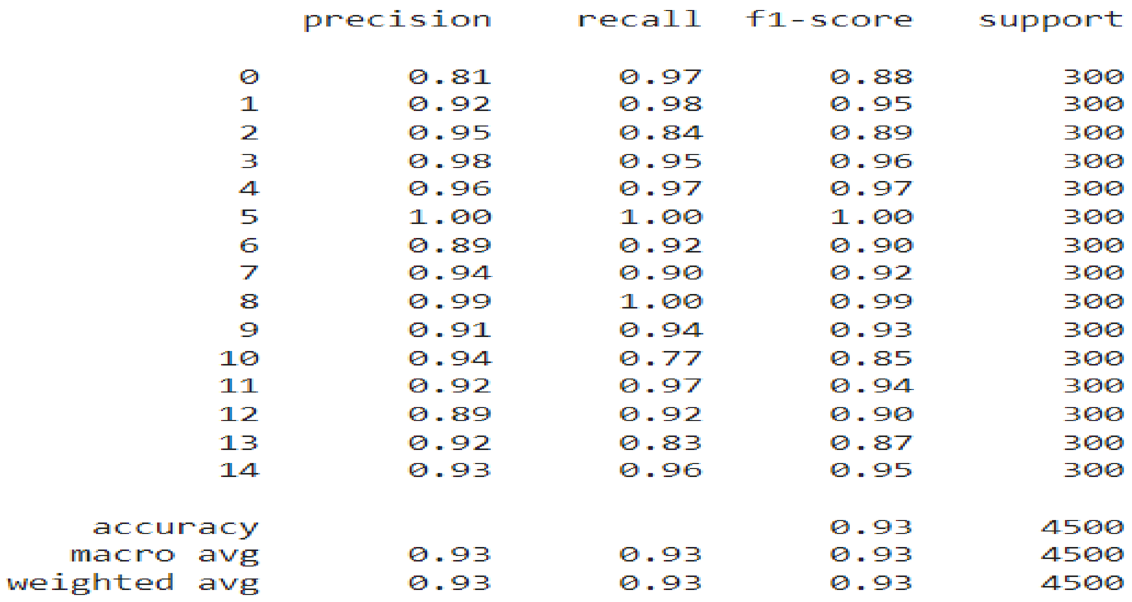
Precision is defined as the number of true positives divided by the sum of true and false positives. Precision expresses the proportion of data correctly predicted as positive. Using it as a metric, we can define the percent of the predicted class inside the data we classified as that class. In other words, precision helps us measure how often we correctly predicted that a data point belongs to the class our model assigned it to. The equation for it is:

Precision = (True Positive) / (True Positive + False Positive)

Recall (Sensitivity, True Positive Rate)

We define recall as the number of true positives divided by the sum of true positives and false negatives. It expresses the ability to find all relevant instances in a dataset. Recall measures how good our model is at correctly predicting positive cases. It’s the proportion of actual positive cases which were correctly identified. The equation for recall is:

Recall = (True Positive) / (True Positive + False Negative)



```
              precision    recall  f1-score   support

           0       0.81      0.97      0.88       300
           1       0.92      0.98      0.95       300
           2       0.95      0.84      0.89       300
           3       0.98      0.95      0.96       300
           4       0.96      0.97      0.97       300
           5       1.00      1.00      1.00       300
           6       0.89      0.92      0.90       300
           7       0.94      0.90      0.92       300
           8       0.99      1.00      0.99       300
           9       0.91      0.94      0.93       300
          10       0.94      0.77      0.85       300
          11       0.92      0.97      0.94       300
          12       0.89      0.92      0.90       300
          13       0.92      0.83      0.87       300
          14       0.93      0.96      0.95       300

    accuracy                           0.93      4500
   macro avg       0.93      0.93      0.93      4500
weighted avg       0.93      0.93      0.93      4500
```

Fig.3.6 Precision ,Recall and F1 score of model

CHAPTER-4
SOFTWARE AND HARDWARE REQUIREMENTS

4.1 INTRODUCTION

To install and use the application efficiently, we required certain software and hardware components of the computer system. The system requirements on the package will be listed by the application manufacturer. After installation of the application, you could face technical issues, if your computer system does not meet the system requirements. System requirements for operating system will be hardware components, while other application software will list both hardware and operating system requirements and Brower. System requirements are most commonly seen listed as a minimum and recommended requirement. The minimum system requirements need to be met for the web application to run at all on your system, & the recommended system requirements, if met, will offer better software usability.

4.2 SOFTWARE REQUIREMENTS

Required software to work on this project:

- **Operating System:** Window

- **Languages** :
  - HTML
  - CSS
  - python

- **Frame Works :**
  - Backend – Django

- **Libraries :**
  - Tensorflow
  - Keras
  - Matplotlib
  - Numpy
  - Os
  - Pickle
  - CV2
  - Seaborn

- **Tools:**
  - Visual Studio Code
  - Google Colaboratory

Languages:

HTML

Stands for "Hypertext Markup Language." HTML is the language used to create web pages. "Hypertext" refers to the hyperlinks that an HTML page may contain. "Markup language" refers to the way tags are used to define the page layout and elements within the page.

CSS

Stands for "Cascading Style Sheet." Cascading style sheets are used to format the layout of Web pages. They can be used to define text styles, table sizes, and other aspects of Web pages that previously could only be defined in a page's HTML.

Python

Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small- and large-scale projects.

Frameworks:

Django

Django is a Python-based web framework which allows you to quickly create web application without all of the installation or dependency problems that you normally will find with other frameworks.

Libraries:

Tensorflow

TensorFlow is a software library or framework, designed by the Google team to implement machine learning and deep learning concepts in the easiest manner. It combines the computational algebra of optimization techniques for easy calculation of many mathematical expressions.

Keras

Keras is based on minimal structure that provides a clean and easy way to create deep learning models based on TensorFlow or Theano. Keras is designed to quickly define deep learning models.

Matplotlib

Matplotlib is an amazing visualization library in Python for 2D plots of arrays. Matplotlib is a multi-platform data visualization library built on NumPy arrays and designed to work with the broader SciPy stack. It was introduced by John Hunter in the year 2002.

Numpy

NumPy is a Python package. It stands for 'Numerical Python'. It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

OS

The OS module in Python provides functions for creating and removing a directory (folder), fetching its contents, changing and identifying the current directory, etc. You first need to import the os module to interact with the underlying operating system.

Pickle

Pickle in Python is primarily used in serializing and deserializing a Python object structure. In other words, it's the process of converting a Python object into a byte stream to store it in a file/database, maintain program state across sessions, or transport data over the network.

CV2

CV2 is the module import name for opencv-python, "Unofficial pre-built CPU-only OpenCV packages for Python". The traditional OpenCV has many complicated steps involving building the module from scratch, which is unnecessary. I would recommend remaining with the opencv-python library.

Seaborn

Seaborn is a Python data visualization library based on matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics.

Tools:

Visual Studio Code

Visual Studio Code is a source-code editor made by Microsoft for Windows, Linux, and macOS.[9] Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git

Google Colab

Colab is a free Jupyter notebook environment that runs entirely in the cloud it has many libraries,pre-installed to manipulate data and train Machine learning and deep learning models, even using the cloud machine’s GPU.

4.3 HARDWARE REQUIREMENTS

4.3.1 PROCESSOR Minimum - Intel core i3 2nd generation

4.3.2 RAM Minimum - 2 GB

4.3.3 HARDISK Minimum – 250GB

CHAPTER-5
SOFTWARE REQUIREMENT SPECIFICATION

5.1 FUNCTIONAL REQUIREMENTS

The functional requirements that take some input and perform some tasks then produced the output thus these types of requirements are known as functional requirements. The functional requirements are classified into two categories namely admin and user requirements

5.1.1 Actor Developer

- **Contact us**
- **Maintenance and Repair**

Description:-

Developer will view and reply to the feedback using email and solve the reported error.

5.1.2 Actor User

- **Perform Image Classification**
  - Upload Image
  - Submit
- **Contact Us**
  - Give Feedback
  - Report Error

Description:-

Users can perform the image classification by uploading an image of the plant's leaf or fruit. Users can select the model to perform classification and submit it to get the result , Users can also be able to give feedback and report any error via email.

5.2 NON FUNCTIONAL REQUIREMENTS

5.2.1 Adaptability

The models which are currently being used can be changed.

5.2.2 Correctness

The models are tested on the same image which is uploaded by the actor.

5.2.3 Flexibility

If need arises in the future, software can be modified to change the requirements.

5.2.4 Maintainability

Software can be easily repaired and modified if a fault occurs.

5.2.5 Reliability

Software is prone to user’s human error or mistakes and instantly gives an exceptional message specifying the issue. In case of any external system failure the software detects it and instantly kills the application.

CHAPTER-6
SOFTWARE DESGIN

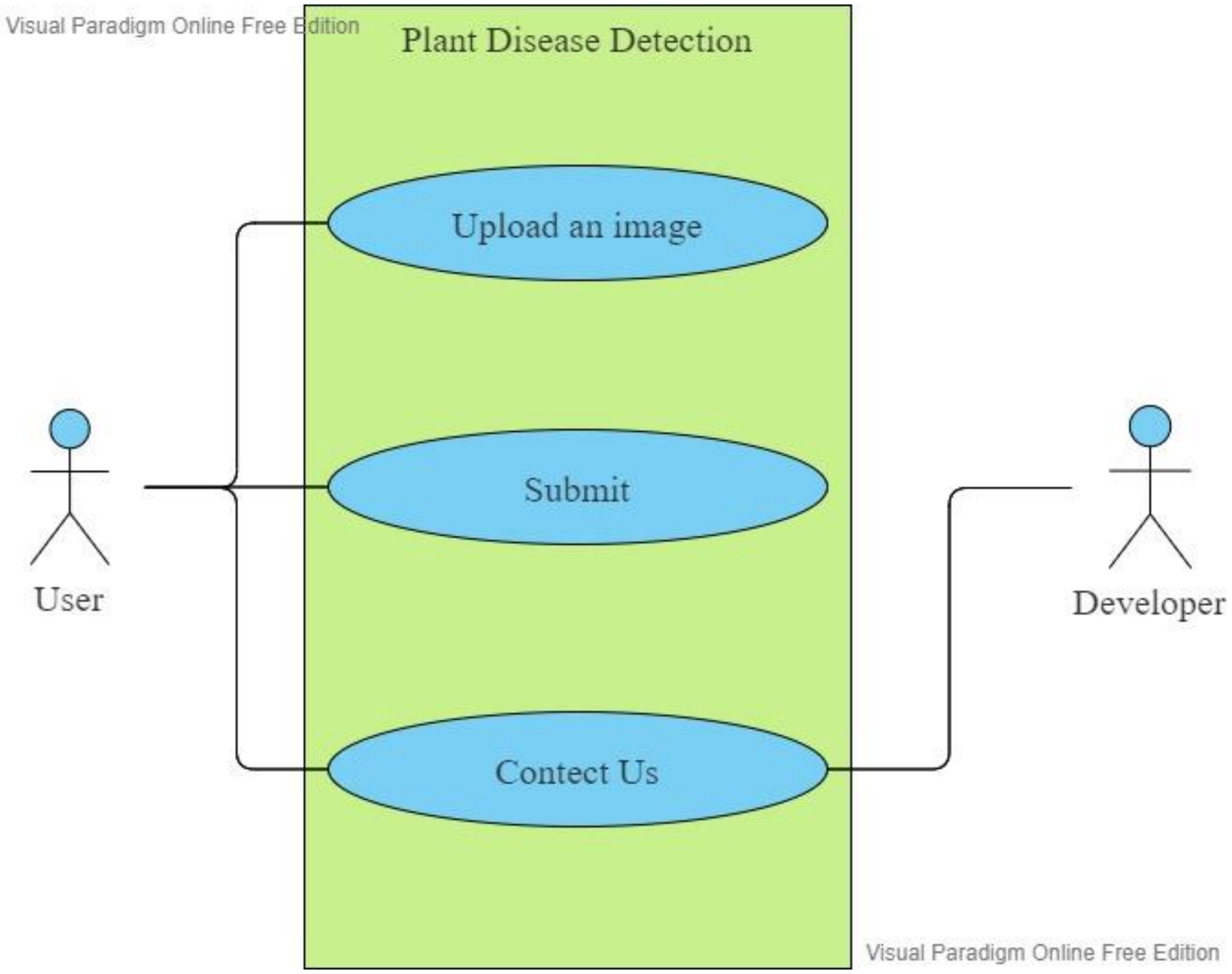
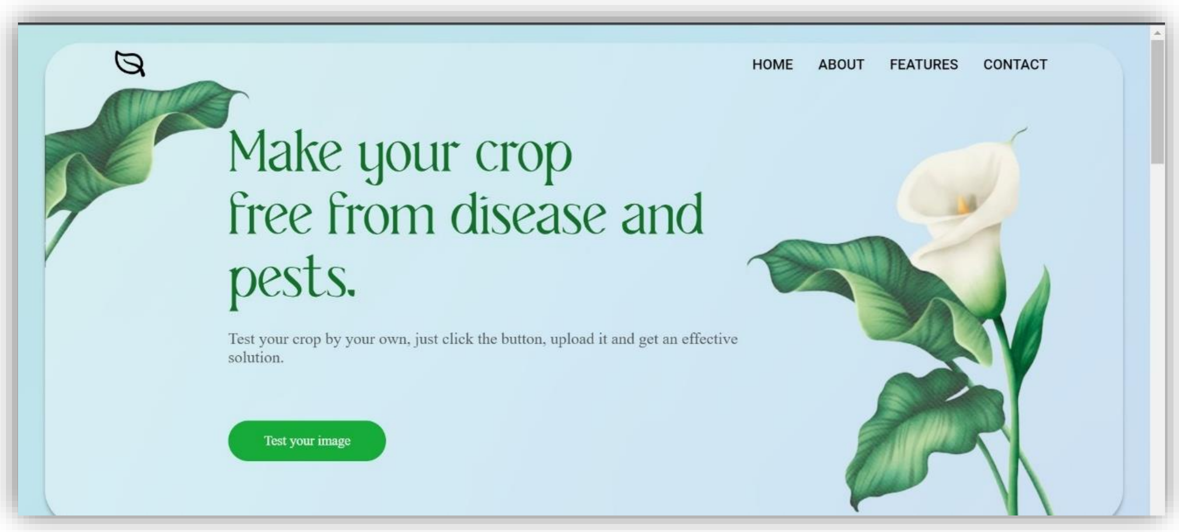

Visual Paradigm Online Free Edition
Plant Disease Detection
Upload an image
Submit
Contect Us
User
Developer
Visual Paradigm Online Free Edition

Fig. 6.1 Use case Diagram

CHAPTER-7
OUTPUT SCREEN AND WORKING



Make your crop free from disease and pests.

Test your crop by your own, just click the button, upload it and get an effective solution.

Fig 7.1 Landing Page

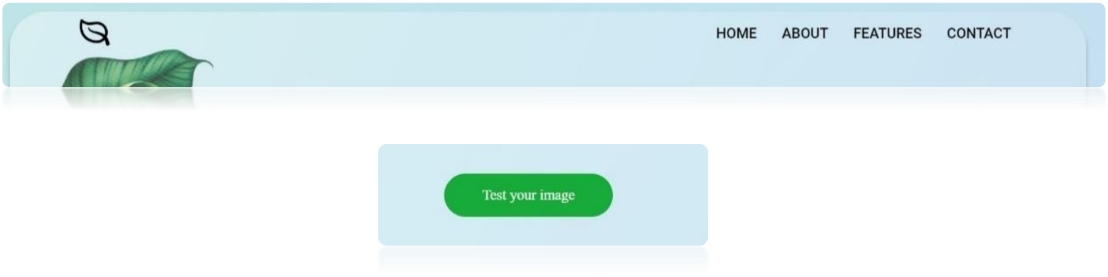


Fig 7.1(a) Navigation bar

Fig 7.1(a) shows navbar of the landing page that contains the home, About, Features , contact us navigation button and about us navigation button which navigates the user to contact us form and about us section respectively and Get Started button which navigates user to diagnose your crop.

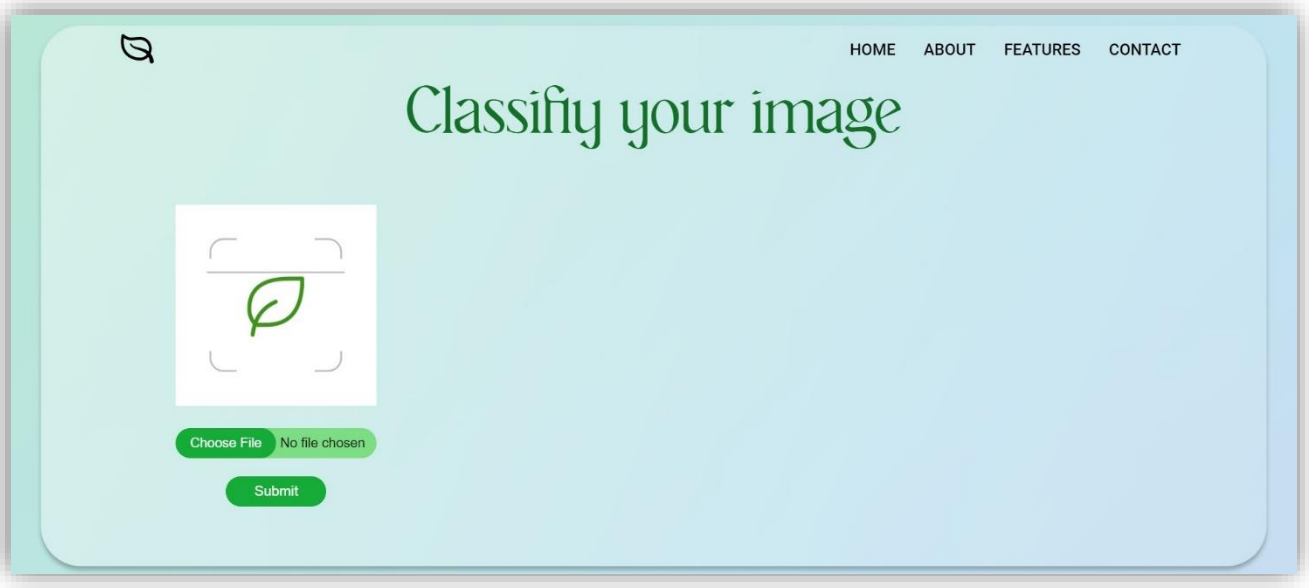
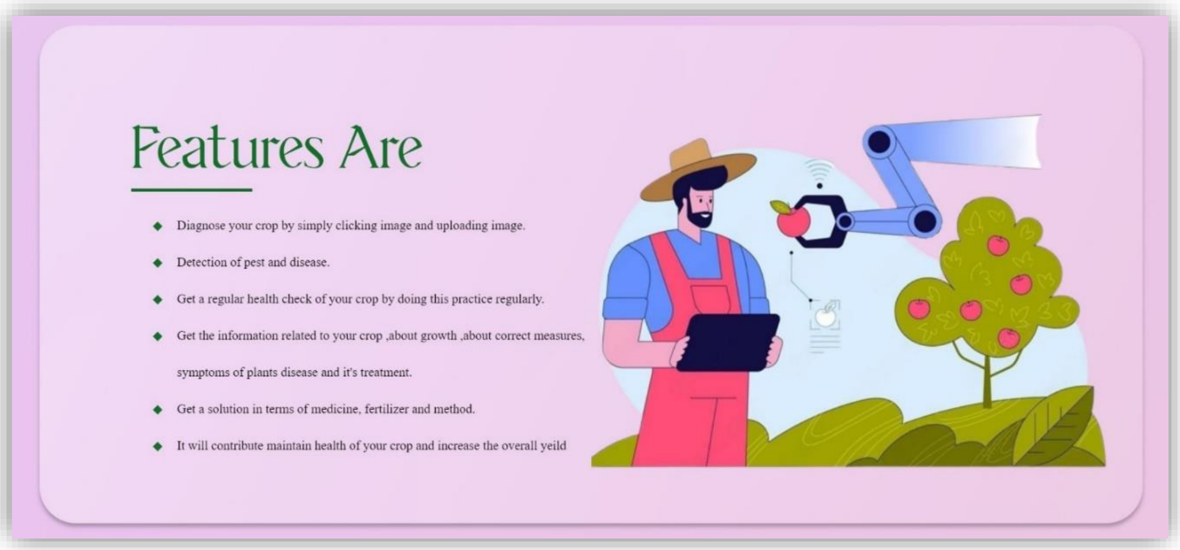


Fig 7.2 Diagnose image page

Fig. 7.2 shows the page where we can perform the classification by uploading the image,

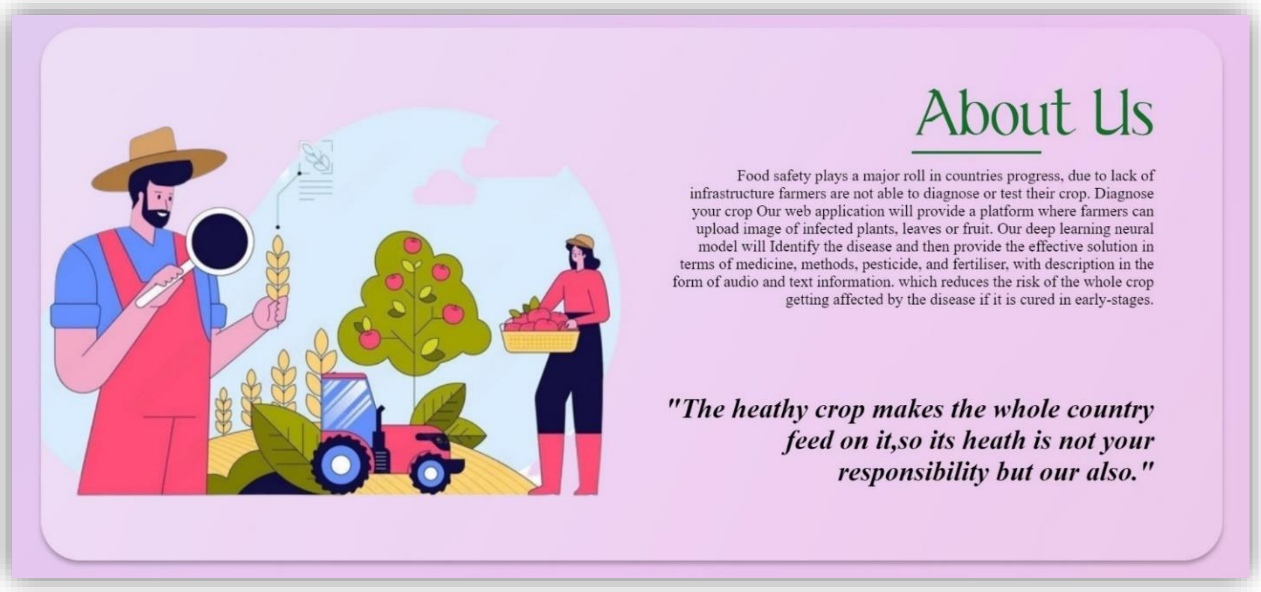
We can Diagnose your crop by simply clicking image and uploading image



Features Are

- Diagnose your crop by simply clicking image and uploading image.
- Detection of pest and disease.
- Get a regular health check of your crop by doing this practice regularly.
- Get the information related to your crop ,about growth ,about correct measures, symptoms of plants disease and it's treatment.
- Get a solution in terms of medicine, fertilizer and method.
- It will contribute maintain health of your crop and increase the overall yeild

Fig 7.3 Our Features

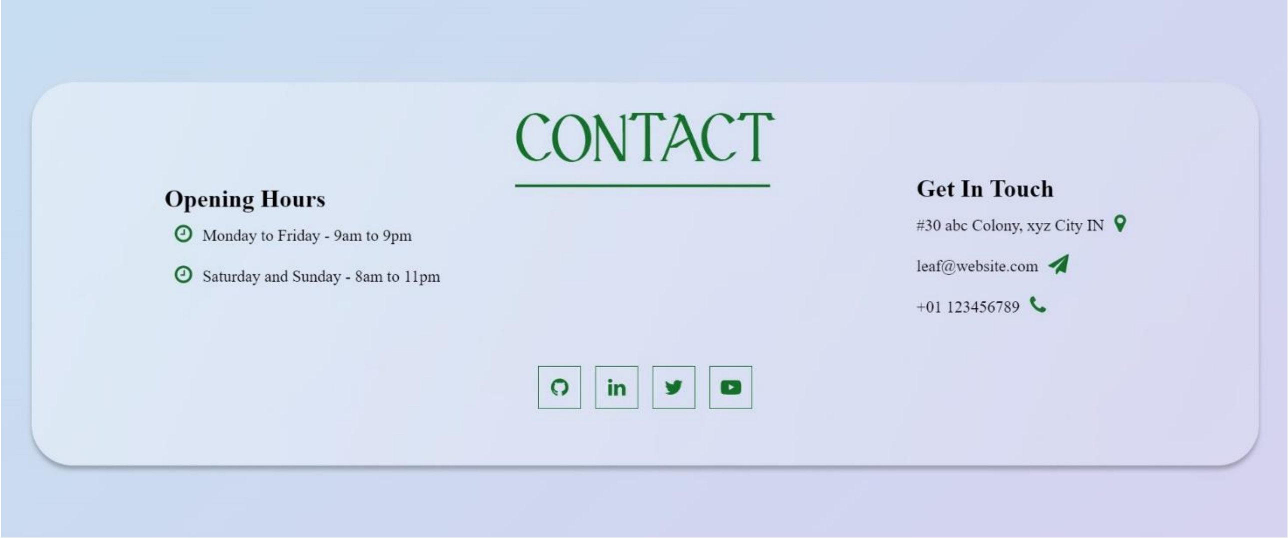


About Us

Food safety plays a major roll in countries progress, due to lack of infrastructure farmers are not able to diagnose or test their crop. Diagnose your crop Our web application will provide a platform where farmers can upload image of infected plants, leaves or fruit. Our deep learning neural model will Identify the disease and then provide the effective solution in terms of medicine, methods, pesticide, and fertiliser, with description in the form of audio and text information. which reduces the risk of the whole crop getting affected by the disease if it is cured in early-stages.

"The heathy crop makes the whole country feed on it,so its heath is not your responsibility but our also."

Fig. 7.4 About us



CONTACT

Opening Hours

- Monday to Friday - 9am to 9pm
- Saturday and Sunday - 8am to 11pm

Get In Touch

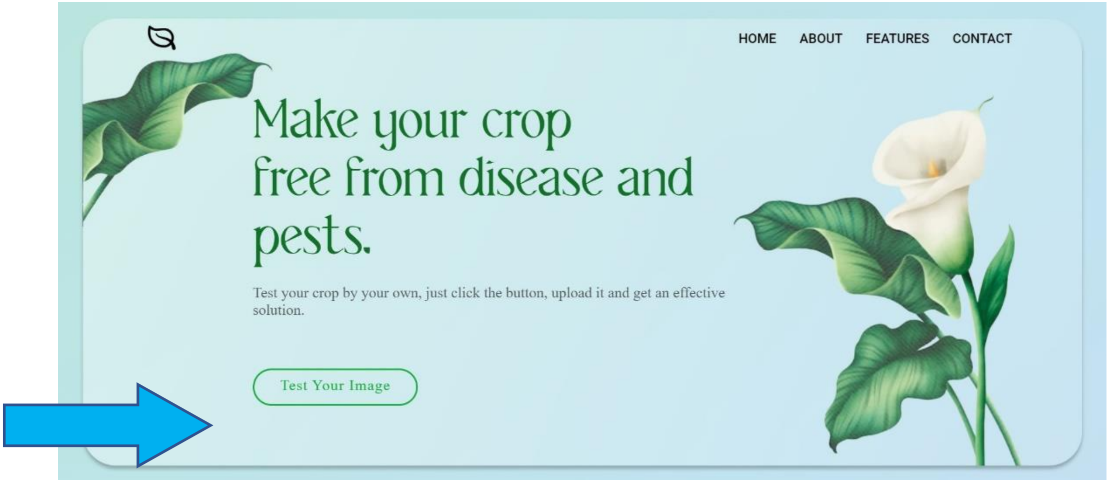
#30 abc Colony, xyz City IN

leaf@website.com

+01 123456789

Fig 7.5 Contact us

WORKING SCREEN OUTPUT

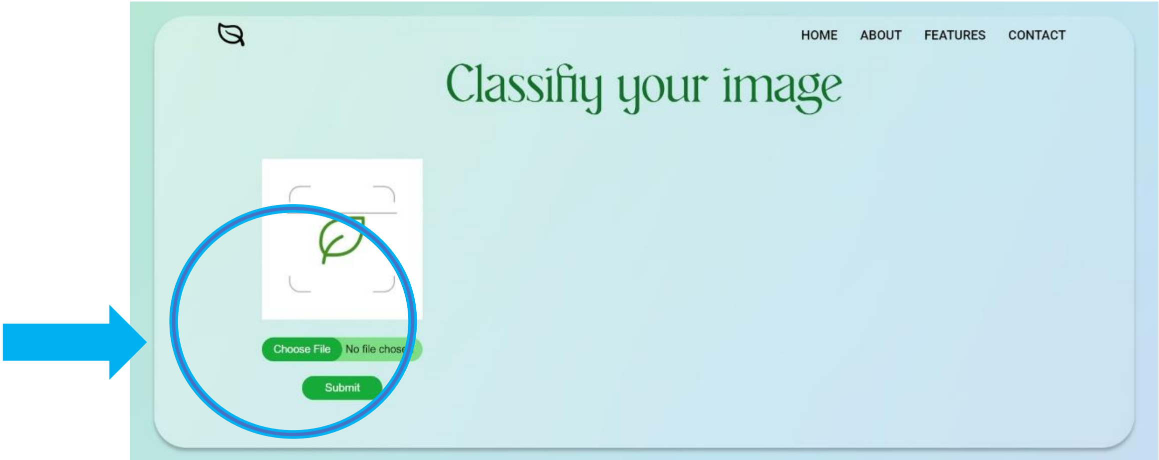


Make your crop free from disease and pests.

Test your crop by your own, just click the button, upload it and get an effective solution.

Fig 7.6 click on ‘Test your Image’

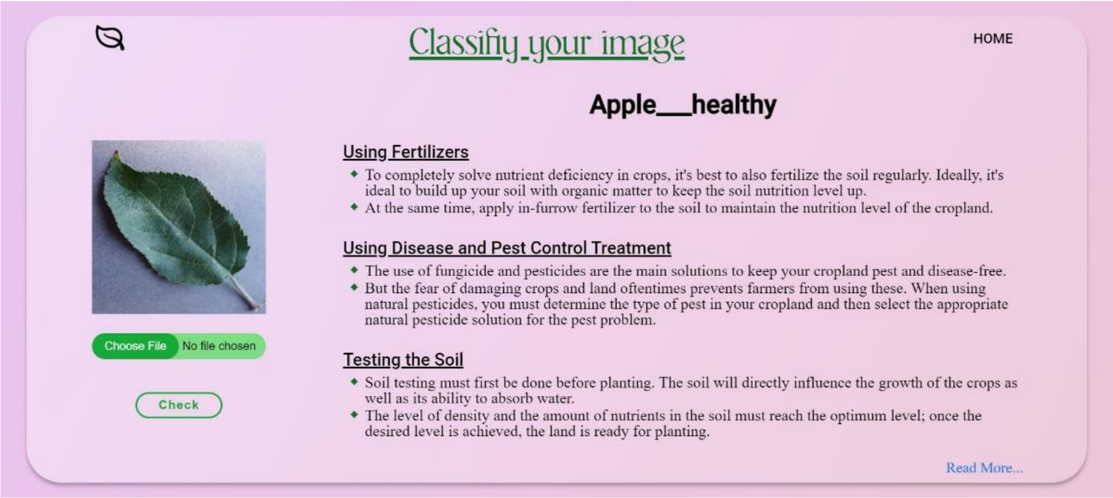
Step 1: On Home page click on test your image button.



Classifiy your image

Fig 7.6(a) Upload Image

Choose the file and upload it and click on submit



Classifiy your image

Apple___healthy

Using Fertilizers

- To completely solve nutrient deficiency in crops, it's best to also fertilize the soil regularly. Ideally, it's ideal to build up your soil with organic matter to keep the soil nutrition level up.
- At the same time, apply in-furrow fertilizer to the soil to maintain the nutrition level of the cropland.

Using Disease and Pest Control Treatment

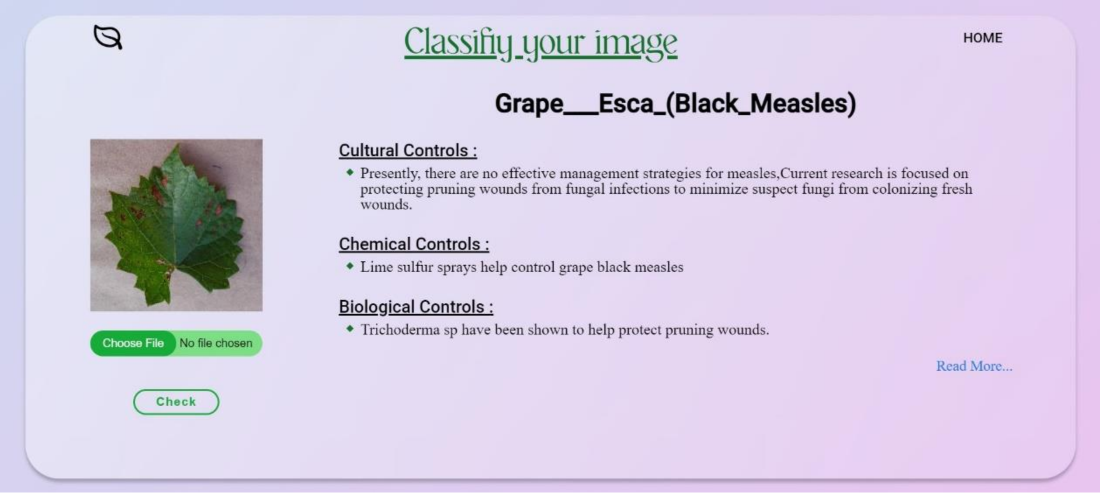
- The use of fungicide and pesticides are the main solutions to keep your cropland pest and disease-free.
- But the fear of damaging crops and land oftentimes prevents farmers from using these. When using natural pesticides, you must determine the type of pest in your cropland and then select the appropriate natural pesticide solution for the pest problem.

Testing the Soil

- Soil testing must first be done before planting. The soil will directly influence the growth of the crops as well as its ability to absorb water.
- The level of density and the amount of nutrients in the soil must reach the optimum level; once the desired level is achieved, the land is ready for planting.

Fig 7.7 Output screen 1

After clicking on submit the model will give predication on crop heath and how to maintain crop health.



Classifiy your image

Grape___Esca_(Black_Measles)

Cultural Controls :

- Presently, there are no effective management strategies for measles,Current research is focused on protecting pruning wounds from fungal infections to minimize suspect fungi from colonizing fresh wounds.

Chemical Controls :

- Lime sulfur sprays help control grape black measles

Biological Controls :

- Trichoderma sp have been shown to help protect pruning wounds.

Fig 7.7(a) Output screen 2

If model detects any disease in crop then it will give suitable treatment for the disease .

CHAPTER-8
CONCLUSION AND FUTURE WORK

The crop disease and pest control are important for farmers and us ,due to lack of sufficient information famers suffers lose ,giving them information and treatment ,help them to increase their production and also the agricultural pharma companies provide the medicines directly to farmers.

India is a huge country and the basic supplies must be surplus and farmers must become strong and capable to feed the country .

FUTURE WORK

Our project is complete however some future enhancements would sure enough create our project a lot more user friendly. Some additional feature that we would like to reinforce:

- Android version
- Applicable for more crops
- Home Delivering mechanism of medicines direct from compan

REFERENCES

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Keras - https://keras.io
Stackoverflow- https://stackoverflow.com
GitHub- https://github.com
Geek for Geeks - https://www.geeksforgeeks.org
Kaggle - https://www.kaggle.com
Code base- https://codebasics.io
Machine learning Mastery -https://machinelearningmastery.com/
Google Colaboratory - https://colab.research.google.com/

APPENDIX 1
GLOSSARY OF TERMS

(In alphabetical order)

A

ASD

Agile Software Development. An approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing and small highly motivated team. It advocates continual improvement and encourages rapid and flexible response to change.

C

CSS

Cascading Style Sheets. CSS describes how HTML elements are to be displayed on screen, paper, or in other media. It can control the layout of multiple web pages all at once.

D

DL

Deep learning. It is a machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher level features from data:

F

FR

Functional Requirements. FR are the working characteristics of a product. These are based on how end users will use the product.

H

HTML

Hypertext Markup Language. HTML is formatting system for displaying material retrieved over the Internet. Each retrieval unit is known as a Web page, and such pages frequently contain hypertext links that allow related pages to be retrieved.

J

JS

JavaScript is a scripting language, primarily used on the Web. It is used to enhance HTML pages and is commonly found embedded in HTML code. JavaScript

M

MVT

The MVT (Model View Template) is a software design pattern. It is a collection of three important components Model View and Template. The Model helps to handle database. It is a data access layer which handles the data.

N

NFR

Non-Functional Requirements. NFRs define system attributes such as security, reliability, performance, maintainability, scalability etc

O

OOP Object Oriented Programming. OOP is a computer programming model that organizes software design around data, or objects, rather than functions and logic.

U

UML

Unified Modelling Language. It is a general-purpose modelling language. It’s not a programming language, it is rather a visual language. UML is linked with object-oriented design and analysis. UML makes the use of elements and forms associations between them to form diagram

PROJECT SUMMARY

About Project

Title of the project	DESIGN AND DEVELOPMENT OF END-TO-END DEEP LEARNING-BASED WEB APPLICATION FOR CROP DISEASE IDENTIFICATION AND TREATMENT
Semester	5th
Members	3
Team Leader	Sanjeev Kumar Singh
Describe role of every member in the project	Sanjeev Kumar Singh :- Deep learning model building and Backend Sachin Kumar :- Front end Sahil Choudhary :- Content
What is the motivation for selecting this project?	Interest in neural network technology
Project Type (Desktop Application, Web Application, Mobile App, Web)	Web - Application

Tools &Technologies

Programming language used	PYTHON, JavaScript (Frontend), HTML (Markup language), CSS (Style cascading language),
IDE used (with version)	Visual studio and google colab
Front End Technologies (with version, wherever Applicable)	HTML, CSS
Back End Technologies (with version, wherever applicable)	Django
Model	Deep learning model
Database used (with version)	no

Software Design& Coding

Is prototype of the software developed?	*Yes*
SDLC model followed (Waterfall, Agile, Spiral etc.)	Agile
Why above SDLC model is followed?	Agile is a SDLC model that defines how software development needs to be done. It's not a single or specific method, and it is the collection of various methodologies and best practices that follow the value statement signed with the customer
Justify that the SDLC model mentioned above is followed in the project.	Since, we didn't exactly know all the functionalities or the functionalities were frequently changing, we use Agile model, so that we could make desired changes whenever needed.
Software Design approach followed (Functional or Object Oriented)	Object Oriented
Name the diagrams developed (according to the Design approach followed)	Use Case diagram
In case Object Oriented approach is followed, which of the OOPS principles are covered in design?	
No. of Tiers (example 3-tier)	3-tier
Total no. of front end pages	5
Front end validations applied (Yes / No)	No
Session management done (in case of web applications)	
Is application browser compatible (in case of web applications)	

Exception handling done (Yes / No)	No
Commenting done in code (Yes / No)	Yes
Naming convention followed (Yes / No)	Yes
What difficulties faced during deployment of project?	During data pre-processing and feature extraction.
Total no. of Use-case s	1
Give titles of Use-cases	Use-case Diagram

Project Requirements

MVC architecture followed (Yes / No)	No
If yes, write the name of MVC architecture followed (MVC-1, MVC-2)	
Design Pattern used (Yes / No)	
If yes, write the name of Design Pattern used	
Interface type (CLI / GUI)	GUI
No. of Actors	2
Name of Actors	User , Developer
Total no. of Functional Requirements	2
List few important non-Functional Requirements	Correctness, Flexibility, Reliability and Maintainability.

Testing

Which testing is performed? (Manual or Automation)	Manual
Is Beta testing done for this project?	No

Write project narrative covering above mentioned points

This deep learning web application has function of image recognition. The primary programming language is python. Our front end is built using HTML ,CSS , Javascript . Our platform will help farmers to diagnose their crop simply by clicking image , by deep learning neural network model.

This project is divided into two stages for the whole project :

1.Upoading : In this stage , the user will click and upload the picture of image.

2.Treatment : If plant found infected then it recommends suitable medicine for treatment.

Sanjeev Kumar Singh

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Sachin Kumar

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Project guide
Prof.Rahul Dubey