

Birla Vishvakarma Mahavidyalaya  
Engineering College  
[An Autonomous Institution]

A  
Project Report  
On

**Plant Care Management**

Under the course of  
**DESIGN ENGINEERING -3CP08**  
B. E. , Semester – IV  
(Computer Engineering)

**Submitted by:**

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Academic year  
(2020-2021)

# CERTIFICATE

This is to certify that the students namely, **Ms. Sharlin Parmar (18CP002), Mr. Harsh Upadhyay (18CP027), Ms. Dhruvi Kunvarani (18CP038)** of **B. E. (Computer Engineering) Semester VI** have successfully completed the course work and related tasks for the course of **Design Engineering 3CP08** during the academic term ending in the month of May 2021.

Date: 20-04-2021

Place: Birla Vishwakarma Mahavidyalaya

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# 1. Introduction

Gardening has been the interest of a large number of people for a long time. Currently to get information about plants, generally users need to roam around a couple of websites.

Recent developments in machine learning and artificial intelligence along with the ever-increasing performance of modern-day computers have enabled the use of these technologies that can recognize plants from their images.

- It is a system that allows you to show your plant's photo, and it gives you information about the plant and also about optimal conditions to take care of the plant.
- If the plant has a disease, it will let you know what that disease is and will give you basic information on how to cure that disease.
- Upload a plant image to get information about it if no information is present with the user.

The purpose of Plants Care Management is to develop a website where a gardening enthusiast can achieve information about plants at one place at a single place. They can get certain diagnostics about the plants as well.

The tools used in this project and described in this document are:

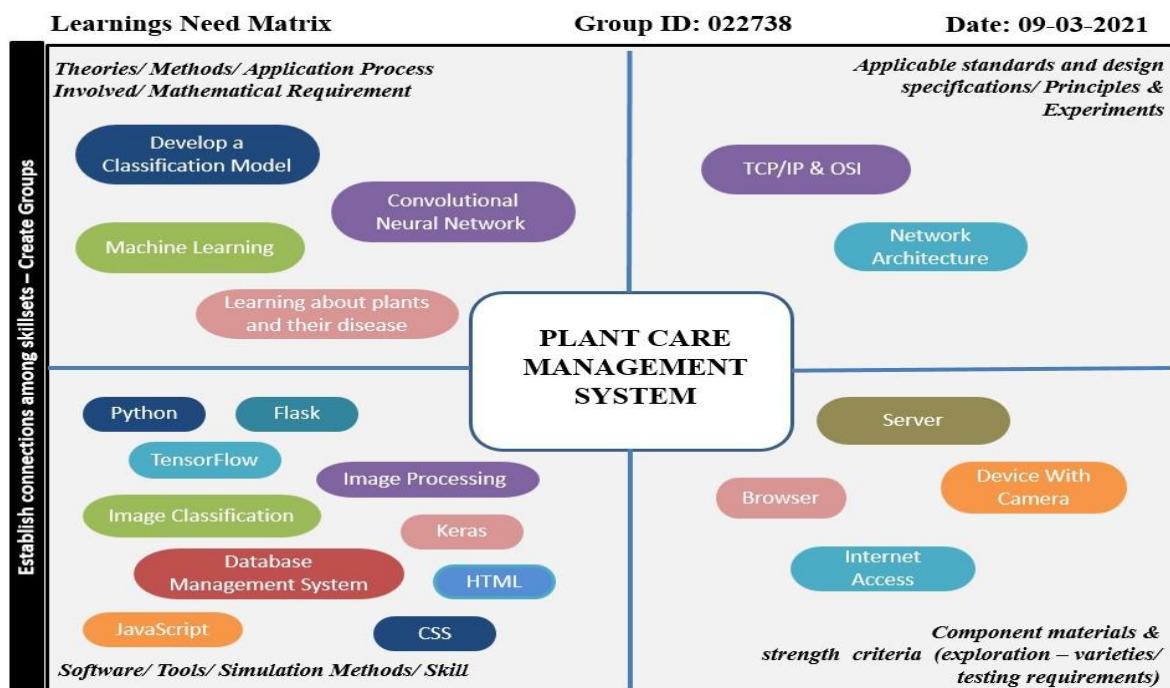
- TensorFlow library for machine learning.
- Flask framework for designing the website.

## 2. Literature Review/Secondary Research

LNM Matrix:

The purpose of LNM is to identify the requirements of learning among the team members. While a new product/process is under development based on a unique idea (to reduce the level of difficulty faced by a user), the team members need to learn and explore a lot of new skills and documents, methods and guidelines.

The LNM is containing a quadratic layout. From the centre (the concept under development), it needs to have mention of learning/exploring requirements in each quadrant representing a specific type of skill acquisition. These quadrants have a timeline associated with it that can be considered in the year of studies (II, III and IV) or phases (short-term, mid-term and long-term). Each identified requirement of learning is connected depending upon interdependencies and paths are to be drawn. The team members can develop their own learning path to contribute to the efforts of the team for developing the concept underlying at the centre of the LNM.



Here are some aspects which are identified in LNM.

- Python

Python is a widely used general-purpose, high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express their concepts in fewer lines of code.

Python is a programming language that lets you work quickly and integrate systems more efficiently.

There are so many applications of Python, here are some of them.

1. Web development
2. Machine learning
3. Data Analysis
4. Scripting
5. Game development – You can develop games using Python.
6. You can develop Embedded applications in Python.
7. Desktop applications

- Machine Learning

Machine learning is a subfield of artificial intelligence (AI). The goal of machine learning generally is to understand the structure of

data and fit that data into models that can be understood and utilized by people.

Although machine learning is a field within computer science, it differs from traditional computational approaches. In traditional computing, algorithms are sets of explicitly programmed instructions used by computers to calculate or problem solve. Machine learning algorithms instead allow for computers to train on data inputs and use statistical analysis in order to output values that fall within a specific range. Because of this, machine learning facilitates computers in building models from sample data in order to automate decision-making processes based on data inputs.

Any technology user today has benefitted from machine learning. Facial recognition technology allows social media platforms to help users tag and share photos of friends. Optical character recognition (OCR) technology converts images of text into movable type. Recommendation engines, powered by machine learning, suggest what movies or television shows to watch next based on user preferences. Self-driving cars that rely on machine learning to navigate may soon be available to consumers.

- Classification Models

Classification models have to conclude the input values we give to the model during training. These models predict the categories (class labels) for the new data we provide to them.

- Multi-Label Classification

Multi-label classification is when we map each sample to a set of target labels of multiple classes. For example, a

school bag could have books, a lunch box, and pens at the same time.

- Multi-Class Classification

Multi-class Classification is when we assign every sample to only a single target label. It takes place when we have more than two classes. For example, a car could be moving or stationary, but not both at the same time.

- Binary Classification

Binary Classification is when we have only two possible classes. For example, a person's gender could be male or female.

- Types of Classification Algorithms

- 1) Kernel Estimation
- 2) Linear Classifiers
- 3) Quadratic Classifiers
- 4) Neural Networks
- 5) Learning Vector Quantization
- 6) Support Vector Machines

- Convolutional Neural Network

A Convolutional neural network (CNN) is a neural network that has one or more convolutional layers and are used mainly for image processing, classification, segmentation and also for other auto correlated data.

The most common use for CNNs is image classification, for example identifying satellite images that contain roads or

classifying handwritten letters and digits. There are other quite mainstream tasks such as image segmentation and signal processing, for which CNNs perform well at.

CNNs have been used for understanding in Natural Language Processing (NLP) and speech recognition, although often for NLP Recurrent Neural Nets (RNNs) are used.

- Flask

Flask is an API of Python that allows us to build up web-applications. It was developed by Armin Ronacher. Flask's framework is more explicit than Django's framework and is also easier to learn because it has less base code to implement a simple web-Application. A Web-Application Framework or Web Framework is the collection of modules and libraries that helps the developer to write applications without writing the low-level codes such as protocols, thread management, etc. Flask is based on WSGI(Web Server Gateway Interface) toolkit and Jinja2 template engine.

- Tensorflow & Keras

- *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.

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- o *Keras*

Keras runs on top of open source machine libraries like TensorFlow, Theano or Cognitive Toolkit (CNTK). Theano is a python library used for fast numerical computation tasks. TensorFlow is the most famous symbolic math library used for creating neural networks and deep learning models. TensorFlow is very flexible and the primary benefit is distributed computing. CNTK is a deep learning framework developed by Microsoft. It uses libraries such as Python, C#, C++ or standalone machine learning toolkits. Theano and TensorFlow are very powerful libraries but difficult to understand for creating neural networks.

Keras is based on a 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. Well, Keras is an optimal choice for deep learning applications.

Keras leverages various optimization techniques to make high level neural network API easier and more performant. It supports the following features –

- Consistent, simple and extensible API.
- Minimal structure - easy to achieve the result without any frills.

- It supports multiple platforms and backends.
- It is a user friendly framework which runs on both CPU and GPU.
- Highly scalability of computation.

- Image Classification & Image Processing

- *Image Classification*

Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps. Depending on the interaction between the analyst and the computer during classification, there are two types of classification: supervised and unsupervised.

Supervised classification uses the spectral signatures obtained from training samples to classify an image.

Unsupervised classification finds spectral classes (or clusters) in a multiband image without the analyst's intervention.

Steps to Build Image Classification Model:

1. Loading and preprocessing Data – 30% time
2. Defining Model architecture – 10% time
3. Training the model – 50% time
4. Estimation of performance – 10% time

- *Image Processing*

Digital Image Processing means processing digital images by means of a digital computer. We can also say that it is a

use of computer algorithms, in order to get enhanced images either to extract some useful information.

Image processing mainly include the following steps:

- 1.Importing the image via image acquisition tools;
- 2.Analysing and manipulating the image;
- 3.Output in which result can be altered image or a report which is based on analysing that image.

- Database Management System(DBMS)

Database Management System (DBMS) is a software for storing and retrieving users' data while considering appropriate security measures. It consists of a group of programs which manipulate the database. The DBMS accepts the request for data from an application and instructs the operating system to provide the specific data. In large systems, a DBMS helps users and other third-party software to store and retrieve data.

DBMS allows users to create their own databases as per their requirement. The term “DBMS” includes the user of the database and other application programs. It provides an interface between the data and the software application.

- Web Technologies
  - HTML

The HyperText Markup Language, or HTML is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such

as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.

- CSS

Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language such as HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.

CSS is designed to enable the separation of presentation and content, including layout, colors, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics, enable multiple web pages to share formatting by specifying the relevant CSS in a separate .css file which reduces complexity and repetition in the structural content as well as enabling the .css file to be cached to improve the page load speed between the pages that share the file and its formatting.

- JavaScript

JavaScript is a lightweight, interpreted programming language. It is designed for creating network-centric applications. It is complementary to and integrated with

Java. JavaScript is very easy to implement because it is integrated with HTML. It is open and cross-platform.

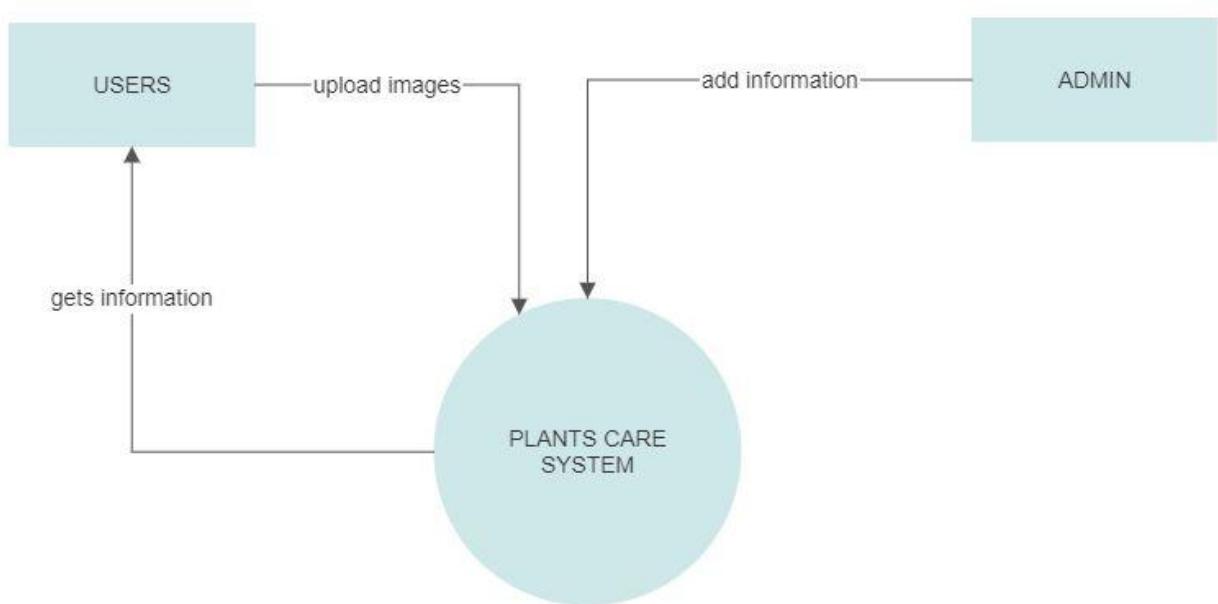
### 3. Design Considerations for the detail design part.

- DataFlow Diagram

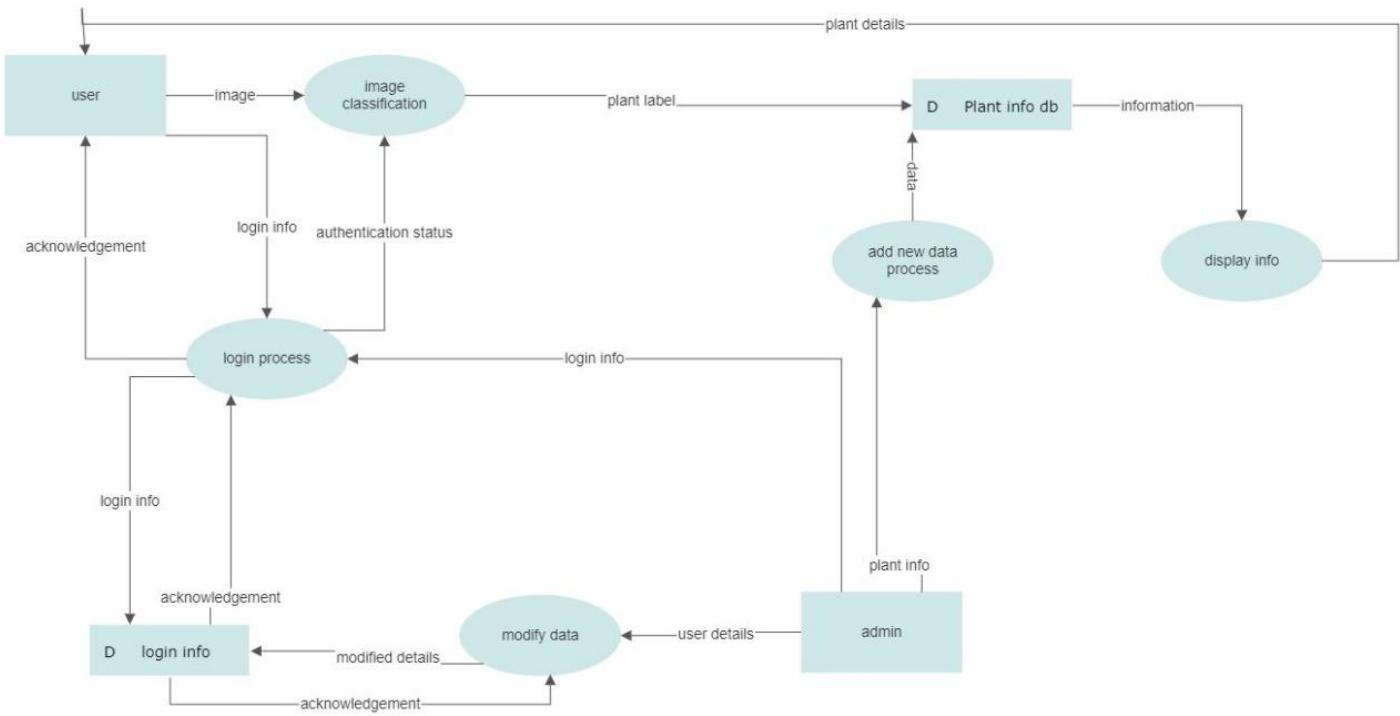
Data flow diagrams are used to graphically represent the flow of data in a business information system. DFD describes the processes that are involved in a system to transfer data from the input to the file storage and reports generation.

Data flow diagrams can be divided into logical and physical. The logical data flow diagram describes flow of data through a system to perform certain functionality of a business. The physical data flow diagram describes the implementation of the logical data flow.

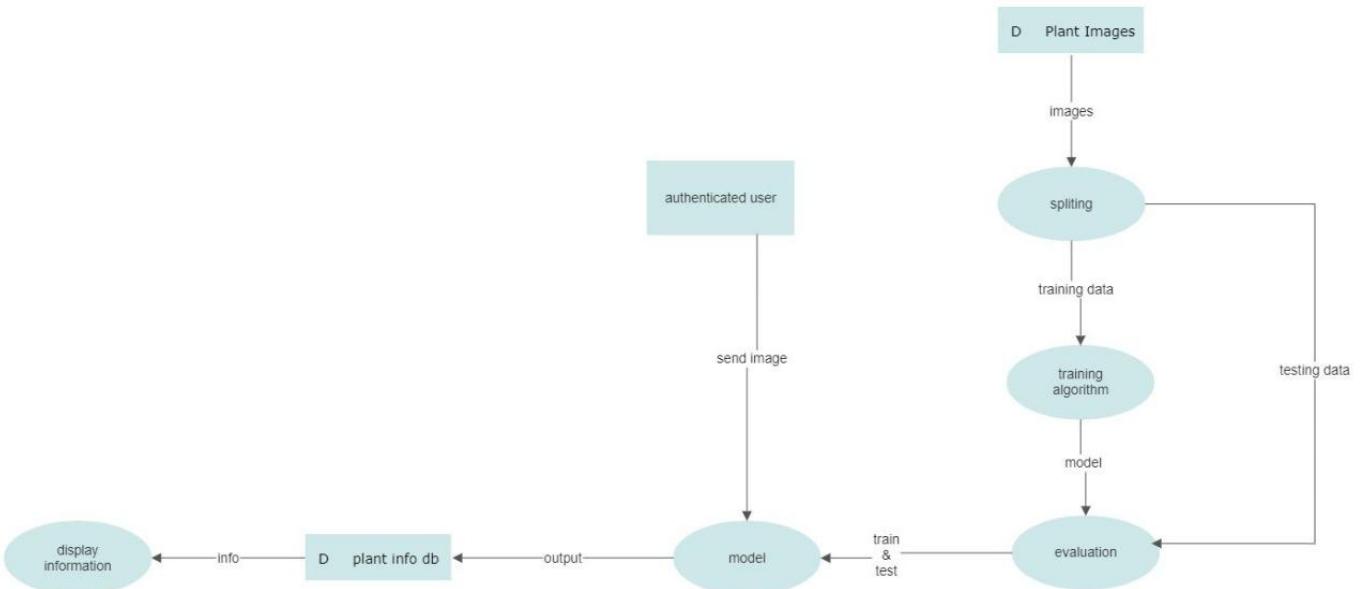
- *Level 0*



○ Level 1



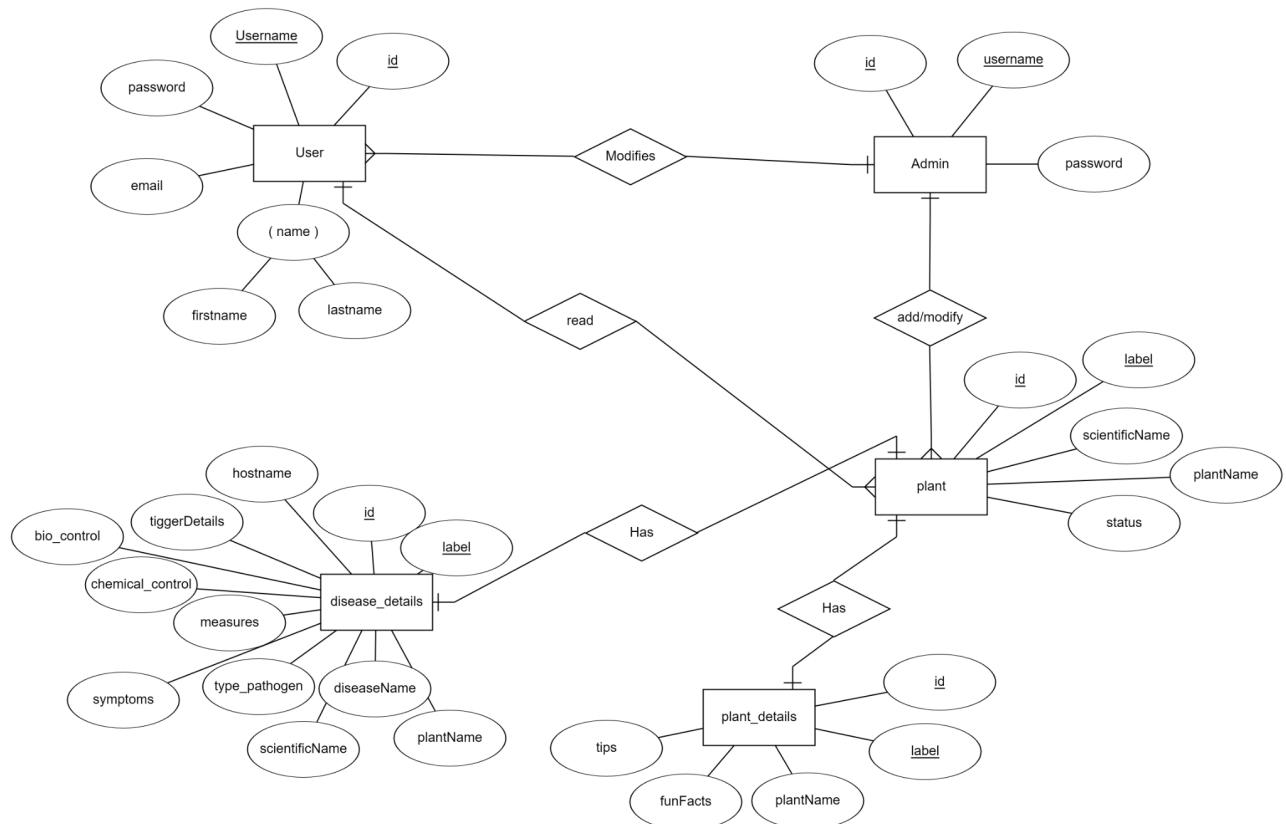
○ Level 2



- ER Diagram

An Entity–relationship model (ER model) describes the structure of a database with the help of a diagram, which is known as Entity Relationship Diagram (ER Diagram). An ER model is a design or blueprint of a database that can later be implemented as a database. The main components of E-R model are: entity set and relationship set.

An ER diagram shows the relationship among entity sets. An entity set is a group of similar entities and these entities can have attributes. In terms of DBMS, an entity is a table or attribute of a table in database, so by showing relationship among tables and their attributes, ER diagram shows the complete logical structure of a database.



## 4. AEIOU Canvas & Product Development Canvas

- *AEIOU Canvas*

AEIOU is an investigative tool to help interpret observations gathered by ethnographic practices in the field. It is an Observation tool. Its two primary functions are to code data, and to develop building blocks of models that will ultimately address the objectives and issues of a client.

AEIOU stands for 5 elements to be coded:

1. Activity
2. Environment
3. Interaction
4. Object
5. User

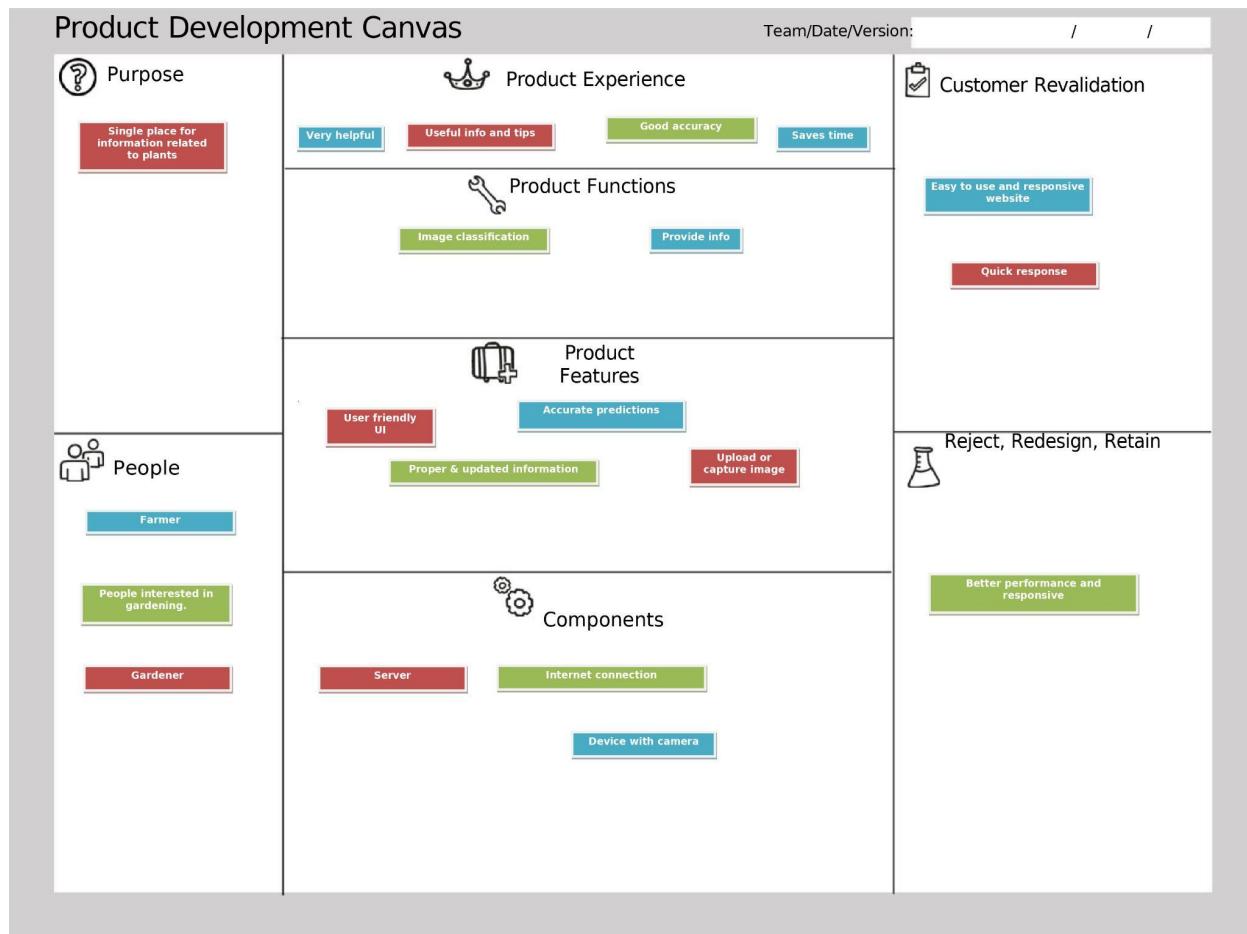
AEIOU Summary:	Group ID:022738 Domain:PlantCare	Date:	Version:1.0.0
Activities:	Plant protection  Weed control  Measures against heat and cold	Different seasons  Day-night  school  office  nursery	gardener  farmer  homemaker  researcher  Nursery owner
Environment:			
Interactions:	Plating the seed  Giving proper shade, sunlight, water  Chopping of extra leaves	Watering plant  Plucking out leaves or flowers  Spraying pesticide	Observing the disease  Setting irrigation system  Taking photo of plant
Object:			plant  pesticides  container  water

## ● *Product Development Canvas*

Remember, a canvas comprises a process that streamlines thought, systematically.

Once an idea is generated, the next step is to identify a product/process (in a comprehensive manner) to resolve the specific difficulty for a user/user group.

The PDC consist of the various sections as User, Purpose, Experience (User Fee i.e. User's feelings, expectations, and experience from the developed product – imagine/visualize this), Functions, Features, components and validation/re-validation.



## **5.Implementation/ Simulation and Analysis (Prototype Software)**

<b>Technologies Used:</b>	Flask(python), HTML, CSS, JavaScript, Bootstrap
<b>Tools:</b>	IDE: Visual Studio Code Database: MySQL Web Browser: Google Chrome Web Server: Flask in-built development server
<b>Python Libraries:</b>	Flask_mail, Flask_mysqldb, Cv2, Datetime, OS, Face_Recognition, Numpy

### **Module Description: -**

The modules of our proposed Plants Care Management are as follows: -

- *User login and registration*

The user i.e., normal user / admin logins into the system using their user id, password.

If a user is not registered, he/she can create an account using email and a unique username and can use it to login and use the product further. In case the user forgets the password, the user can enter username and email and they will receive their password on their email. So this module implements registration of the user and takes care of login as well as forgot password part

- *Admin management*

It deals with adding, deleting and updating the plant's information into our database. Admin can also add users, delete and update the details of a user. This module is for ease of entry into database with directly accessing it and easily updating the plants information

- *Image upload and classification*

This module deals with the image uploading done by user. This image will be saved and then given to the model for further usage. The model will classify it

into a category and depending on that we will fetch information from database. This module is critical for functioning of our product. It takes care about classification of the image

### **Dataset Description: -**

This dataset consists of about 87K rgb images of healthy and diseased crop leaves which is categorized into 38 different classes. The total dataset is divided into 80/20 ratio of training and validation set preserving the directory structure. A new directory containing 33 test images is created later for prediction purpose.

The categories are as follows :

Apple\_\_Cedar\_apple\_rust  
Apple\_\_Apple\_scab  
Tomato\_\_healthy  
Apple\_\_Black\_rot  
Apple\_\_healthy  
Blueberry\_\_healthy  
Cherry\_(including\_sour)\_\_Powdery\_mildew  
Cherry\_(including\_sour)\_\_healthy  
Corn\_(maize)\_\_Cercospora\_leaf\_spot\_Gray\_leaf\_spot...  
Corn\_(maize)\_\_Common\_rust\_  
Corn\_(maize)\_\_Northern\_Leaf\_Blight  
Corn\_(maize)\_\_healthy  
Grape\_\_Black\_rot  
Grape\_\_Esca\_(Black\_Measles)  
Grape\_\_Leaf\_blight\_(Isariopsis\_Leaf\_Spot)  
Grape\_\_healthy  
Orange\_\_Haunglongbing\_(Citrus\_greening)  
Peach\_\_Bacterial\_spot  
Peach\_\_healthy  
Pepper,\_bell\_\_Bacterial\_spot  
Pepper,\_bell\_\_healthy  
Potato\_\_Early\_blight  
Potato\_\_Late\_blight  
Potato\_\_healthy

25	Raspberry__healthy	F
26	Soybean__healthy	S
27	Squash__Powdery_mildew	S
28	Strawberry__Leaf_scorch	S
29	Strawberry__healthy	S
30	Tomato__Bacterial_spot	T
31	Tomato__Early_blight	T
32	Tomato__Late_blight	T
33	Tomato__Leaf_Mold	T
34	Tomato__Septoria_leaf_spot	T
35	Tomato__Spider_mites Two-spotted_spider_mite	T
36	Tomato__Target_Spot	T
37	Tomato__Tomato_Yellow_Leaf_Curl_Virus	T
38	Tomato__Tomato_mosaic_virus	T

#### *Breakdown of the dataset :*

Diseases plants have 26 categories. Count is given here

1. Apple – 3 disease – black rot, apple scab, cedar rust
2. Cherry – 1 disease – powdery mildew
3. Corn – 3 diseases – leaf spot, common rust, leaf blight
4. Grape – 3 diseases – black rot, esca, leaf blight
5. Orange – 1 disease – huanglongbing
6. Peach – 1 disease – bacterial spot
7. Pepper bell – 1 disease – bacterial spot
8. Potato – 2 diseases – early blight, late blight
9. Squash – 1 disease – powdery mildew
10. Strawberry – 1 disease – leaf scorch
11. Tomato – 9 diseases – bacterial spot, early blight, late blight, leaf mold, Septoria leaf spot, spider mite, target spot, mosaic virus, yellow leaf curl virus

Healthy plants have 12 categories. Count is given here

1. Apple
2. Blueberry
3. Cherry
4. Corn
5. Grape
6. Peach
7. Pepper bell
8. Potato
9. Soybean
10. Strawberry
11. Tomato
12. Raspberry

So we will always get predictions in this range.

#### **Database Description: -**

The database of our proposed system is composed of following data-tables:

- **User table** - includes user's data

It has columns like id, username, password, email, first\_name and last\_name

- **Admin table** - includes admin's data

It has columns like id, username and password

- **Plant table** – includes general information about all plants which can be classified by model (healthy as well as unhealthy)

It has columns like id, label, plantName, scientificName, status

- **Disease\_details table** – includes detailed information about all the plants that have diseases.  
It has columns like id, label, diseaseName, plantName, scientificName, type\_pathogen, symptoms, hostname, triggerDetails, bio\_controls, chem\_controls and measures
- **Plant\_details table** – includes detailed information about all the plants that are healthy  
It has columns like id, label, plantName, funFact, tips

### **User Characteristics: -**

#### 1. Admin: -

The administrator can add, delete and update information about the users. Admin can also add, update and delete the available data about the plants .

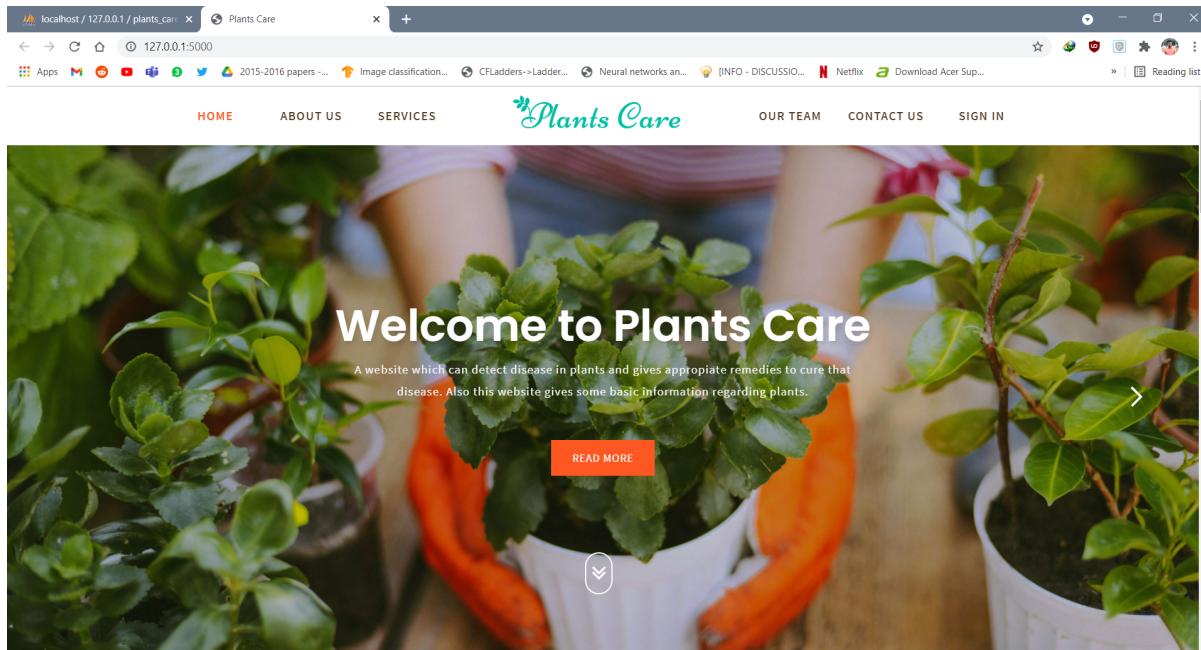
#### 2. User: -

The user i.e., normal user / admin logins into the system using their user id, password.

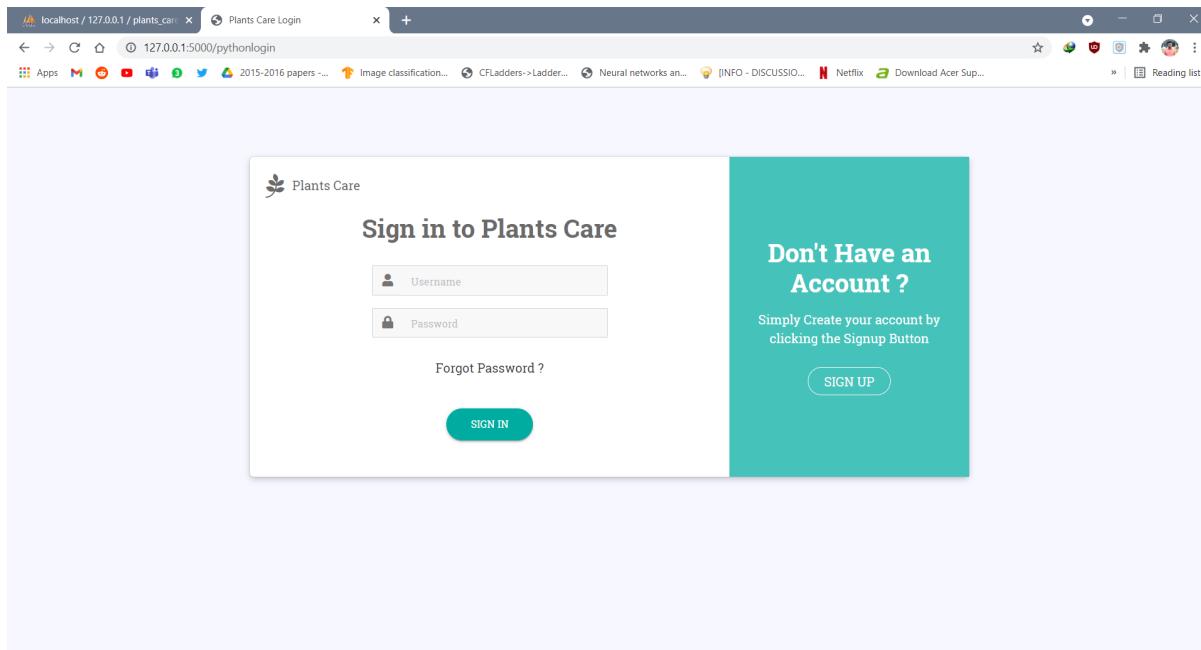
If a user is not registered, he/she can create an account using email and a unique username and can use it to login and use the product further. In case the user forgets the password, the user can enter username and email and they will receive their password on their email. After login, the user uploads an image and gets the particular result in their screen.

Some snapshots of the product:

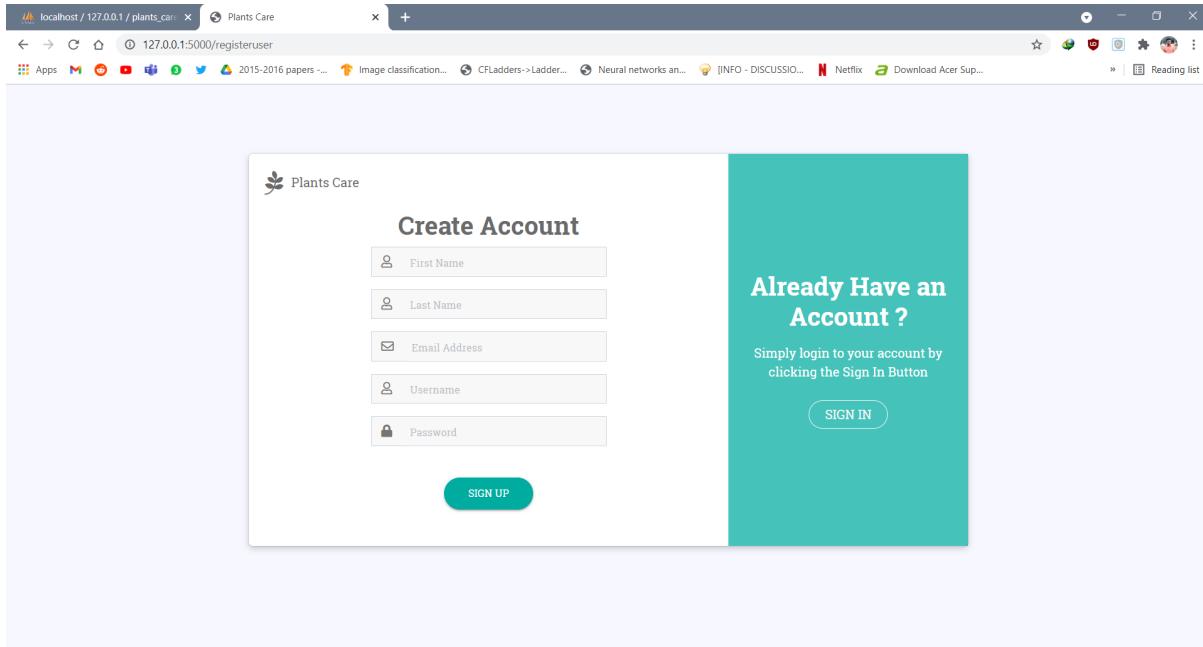
### Home page:



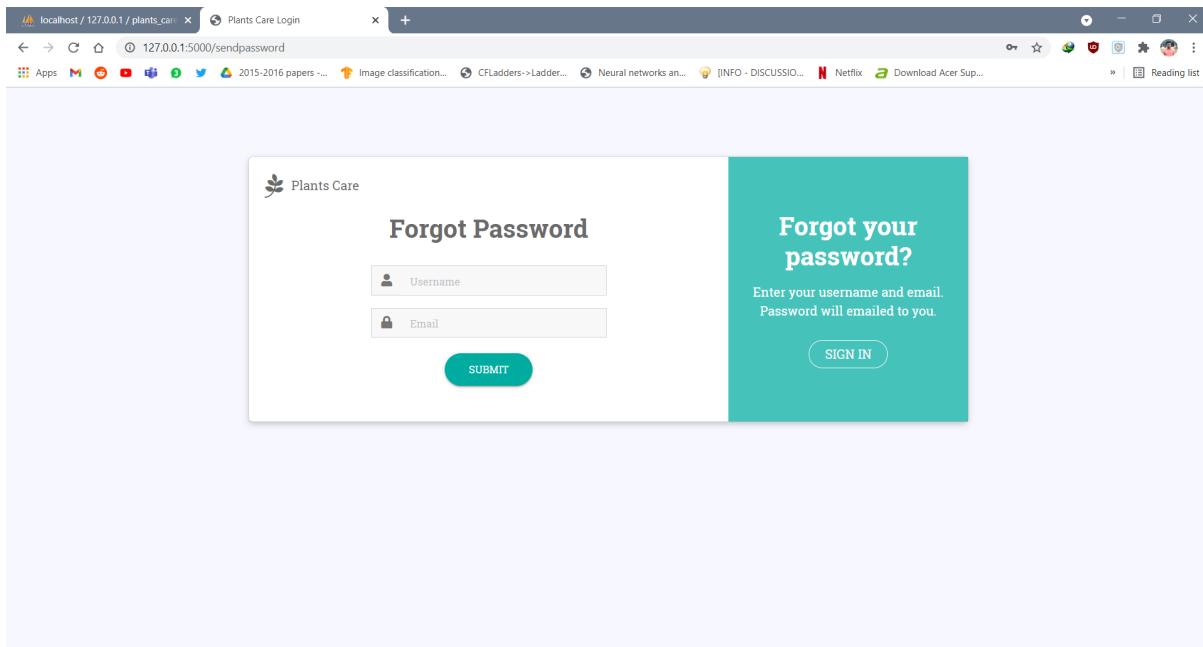
### Login page for user:



## Sign up page for user :

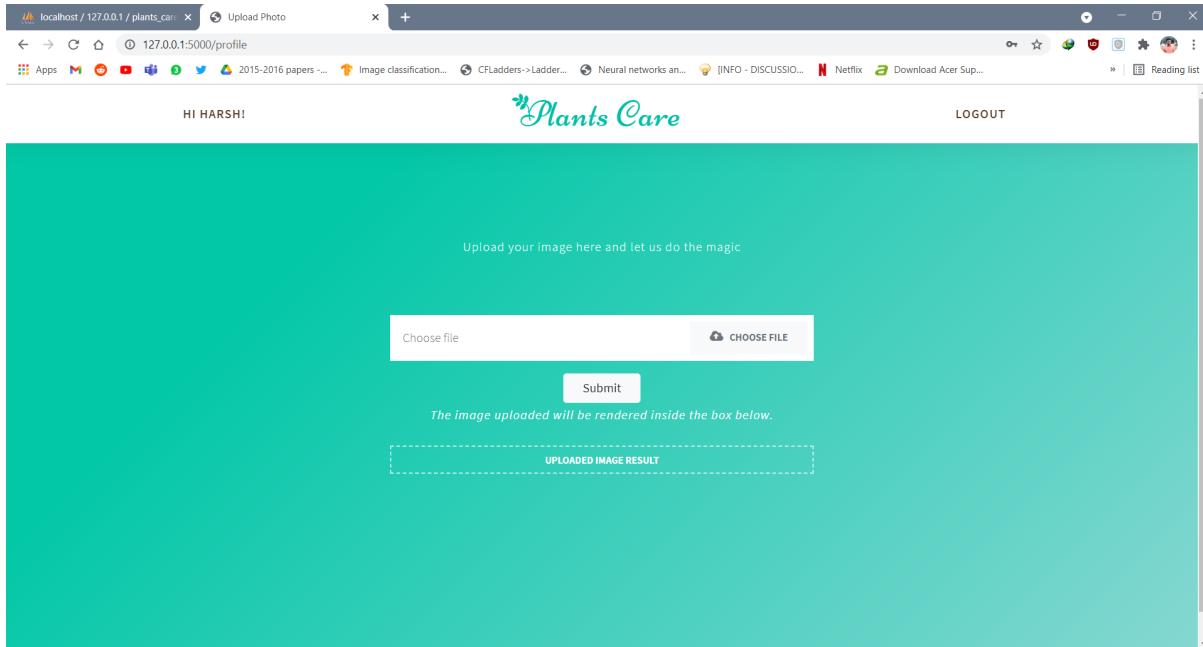


## Forgot password page :

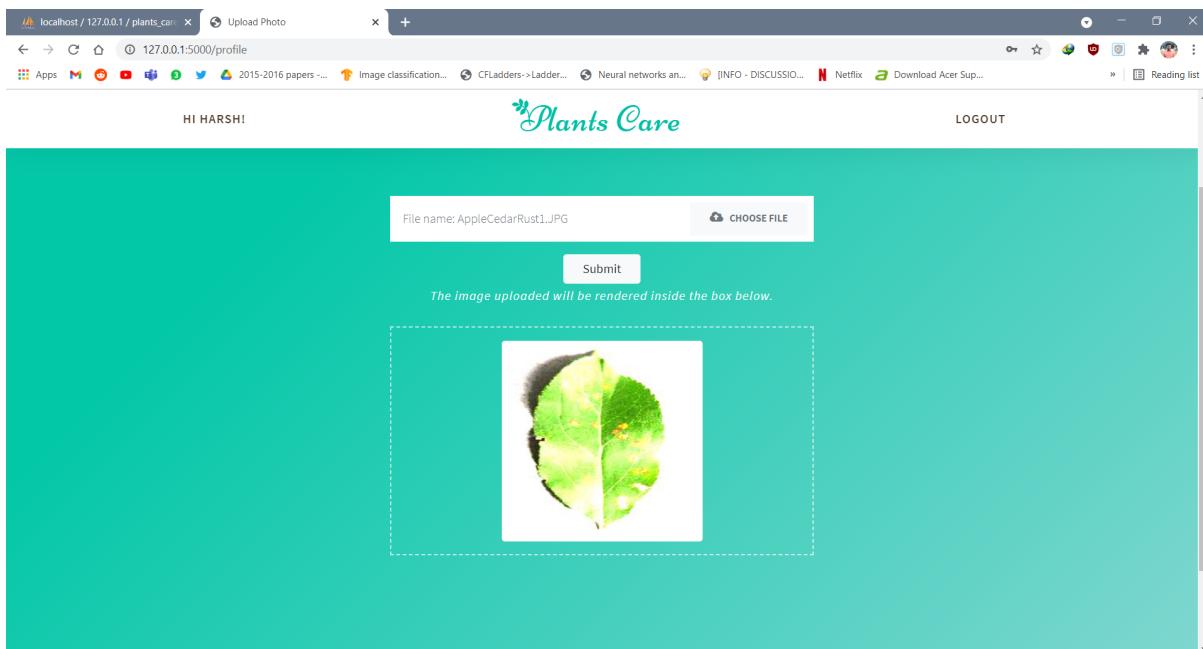


Now we login using id : harsh and password : harsh1234

## So we get the upload page:



## So now we upload an image of plant having disease



## After classification :

The screenshot shows a web browser window with the URL [localhost / 127.0.0.1 / plants\\_care](http://localhost:127.0.0.1/plants_care/). The page title is "Results". The main content area displays the following information:

**DISEASE : CEDAR APPLE RUST**

Plant Name : Apple  
Scientific Name : Malus Domestica  
Pathogen : Fungus  
Status : Not Healthy

### Symptoms:

Large yellow spots appear on cedar-hawthorn rust the upper surface of the leaves turning yellow orange to gray-brown as the spores mature. When rust is severe, all the foliage may turn bright yellow and drop prematurely. The orange leaf spots are smaller on apple and crabapple. Deformation of fruits and young twigs is particularly severe on hawthorns, but this damage is usually caused by the cedar-quince rust fungi and not cedar hawthorn rust fungi.

The screenshot shows a web browser window with the URL [localhost / 127.0.0.1 / plants\\_care](http://localhost:127.0.0.1/plants_care/). The page title is "Results". The main content area displays the following information:

**Hosts:**  
Apple

**Trigger:**  
Cedar apple rust (*Gymnosporangium juniperi-virginianae*) is a fungal disease that requires juniper plants to complete its complicated two year life-cycle. Spores overwinter as a reddish-brown gall on young twigs of various juniper species. In early spring, during wet weather, these galls swell and bright orange masses of spores are blown by the wind where they infect susceptible apple and crab-apple trees. The spores that develop on these trees will only infect junipers the following year. From year to year, the disease must pass from junipers to apples to junipers again; it cannot spread between apple trees.

**Biological Control:**  
The disease can be controlled by eradicating either host in a given area or by timely application of a fungicide, in spring for junipers and in summer for apples.

**Chemical Control:**

localhost / 127.0.0.1 / plants\_care x Results +

← → ⌂ ⌂ 127.0.0.1:5000/upload

Apps M G YouTube F T Google 2015-2016 papers ... Image classification... CFLadders->Ladder... Neural networks an... INFO - DISCUSSIO... Netflix Download Acer Sup... » | Reading list

HI HARSHI UPLOAD SYMPTOMS  CONTROLS MEASURES LOGOUT

Protectant fungicides such as dodine, captan or dinathion can be sprayed around bud break to avoid the disease. Once scab has been detected, fungicides based on difenoconazole, myclobutanil or sulphur can be used to control the development of the fungus. Ensure scab fungicides from different chemical groups are used to avoid the development of resistance.

**Preventive Measures:**

- Use tolerant or resistant varieties.
- Monitor orchards for signs of the disease.
- Pick up affected leaves, shoots and fruits.
- Rake all the fallen leaves from around your trees after harvest.
- Alternatively, apply 5% urea to leaves in the autumn to enhance their decomposition and to obstruct the life cycle of the fungus.
- Excessive leaf litter can also be mowed to speed up the breakdown of tissues.
- Ensure a pruning method that allows for more air circulation.
- Water in the evening or early morning hours and avoid overhead irrigation.
- Avoid getting foliage wet when watering.

## Now we upload an image of healthy plant:

localhost / 127.0.0.1 / plants\_care x Upload Photo +

← → ⌂ ⌂ 127.0.0.1:5000/profile

Apps M G YouTube F T Google 2015-2016 papers ... Image classification... CFLadders->Ladder... Neural networks an... INFO - DISCUSSIO... Netflix Download Acer Sup... » | Reading list

HI HARSHI  LOGOUT

Upload your image here and let us do the magic

File name: PotatoHealthy1.JPG

The image uploaded will be rendered inside the box below.



localhost / 127.0.0.1 / plants\_care x Results x +

← → C ⌘ ⌘ 127.0.0.1:5000/upload

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» | Reading list

HI HARSHI UPLOAD Plants Care TIPS & FACTS LOGOUT

## YIPPIE YOUR PLANT IS HEALTHY



Plant Name : Potato  
Scientific Name : Solanum tuberosum  
Status : Healthy

### Tips to take care:

- When you plant seed potatoes, you are planting a potato produced by the plant the previous year. Any diseases or insects that the mother plant may have had are carried over in the seed potato. Planting certified seed potatoes ensures that you are starting with disease free potatoes.
- Give your potato seeds a head start by pre-sprouting or chitting them before planting into the ground.

localhost / 127.0.0.1 / plants\_care x Results x +

← → C ⌘ ⌘ 127.0.0.1:5000/upload

Apps M G YouTube F T Image classification... CFLadders->Ladder... Neural networks an... INFO - DISCUSSIO... Netflix Download Acer Sup...

» | Reading list

HI HARSHI UPLOAD Plants Care TIPS & FACTS LOGOUT

starting with disease free potatoes.

- Give your potato seeds a head start by pre-sprouting or chitting them before planting into the ground.
- Grow your potatoes where they will receive full sun (6-8 hours per day) planted in an acidic, well-drained soil.
- They can be planted as soon as the ground can be worked in the early spring, once the soil temperature reaches 45° F.
- Maintain a consistent moisture level in the potato bed averaging about 1-2 inches (2.5-5 cm) of water per week.
- Prevent your potatoes from forming green skin by covering with soil or mulching heavily so that no light reaches the tubers.

Facts:

- Potato comes from the Spanish word "Patata".
- China is the world's largest potato producer.
- A potato has only around 100 calories.
- Potatoes are used to make alcoholic beverages.
- You can be poisoned by potatoes.
- Over a billion people eat at least 1 potato each day.

Donate the anonymous website is made up of 100% volunteers and only 200\$ funded

## **6. Conclusion**

Plants Care Management is based on image classification technique. It gives out precious information about the plants which can help gardening enthusiasts, gardeners and even farmers in some cases. The user gets much information in one click in a clean and proper way. This saves a lot of time and that is why Plants Care was created.

## **7. Future scope**

Model accuracy is one aspect that can be worked around in future. Also at present there are 38 categories (26 unhealthy and 12 healthy) in our dataset which can be expanded further which is very helpful. Also the Webcam interface can be added to directly click pictures instead of uploading. Android apps can be developed for the same in order to reach more people.

## **8. Reference**

<https://www.askpython.com/python-modules/flask/flask-mysql-database>

<https://plantix.net/en/>

<https://www.kaggle.com/vipooooool/new-plant-diseases-dataset>

<https://www.tensorflow.org/tutorials/images/classification>

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