FLORA CLASSIFIER USING MACHINE LEARNING

A DESIGN PROJECT REPORT

Submitted by

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in partial fulfillment for the award

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K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

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BONAFIDE CERTIFICATE

Certified that this design project report titled **"FLORA CLASSIFIER USING MACHINE LEARNING"** is the bonafide work of **SANGEETHA.S(REG NO: 811721243047) UDHAYAMALATHI.N(REG NO: 811721243059) VASANTHA PRIYA.M(REG NO: 811721243060)** who carried out the project under my supervision.

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Submitted for the viva-voce examination held on ……

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We jointly declare that the project report on **"FLORA CLASSIFIER USING MACHINE LEARNING"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF TECHNOLOGY**. This design project report is submitted on the partial fulfilment of the requirement of the award of Degree of **BACHELOR OF TECHNOLOGY**.

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ABSTRACT

"Flora Classifier using Machine Learning " project introduces an innovative system that seamlessly combines image recognition and information retrieval for plant enthusiasts cultivating greenery at home. Utilizing a Convolutional Neural Network (CNN), the system accurately identifies home-grown plants based on user-uploaded images. The dataset, comprising diverse household plant species, ensures the model's adaptability to the unique features of home flora.

Beyond plant identification, the system provides a wealth of information, including common and scientific names, optimal growing conditions, care instructions, and medicinal uses. The user-friendly interface allows easy image uploads or manual input, and upon classification, users receive detailed plant profiles, enhancing their understanding and care of the identified plants.

The "Home Flora Classifier" aims to foster a deeper connection between individuals and their home plants, contributing to the growing community of home gardeners. This project not only facilitates plant identification but also serves as an educational resource, encouraging informed decisions about plant care and promoting appreciation for the health benefits associated with home flora.

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LIST OF ABBREVIATIONS

F1	F1 Score
NN	Neural Network
DL	Deep Learning
RF	Random Forest
LR	Logistic Regression
CNN	Convolutional Neural Network
ML	Machine Learning
ARG-CNN	Attention Based Residual Convolutional Neural Network

CHAPTER 1

INTRODUCTION

The resurgence of interest in home gardening and natural remedies has catalyzed a symbiotic relationship between individuals and the greenery within their domestic spaces. As the cultivation of plants within homes gains popularity, the need for a tool that seamlessly identifies and imparts knowledge about these home-grown species becomes increasingly evident. The "Flora Classifier using Machine Learning" emerges as a pioneering solution with comprehensive plant information retrieval to create an intuitive and informative platform for plant enthusiasts.

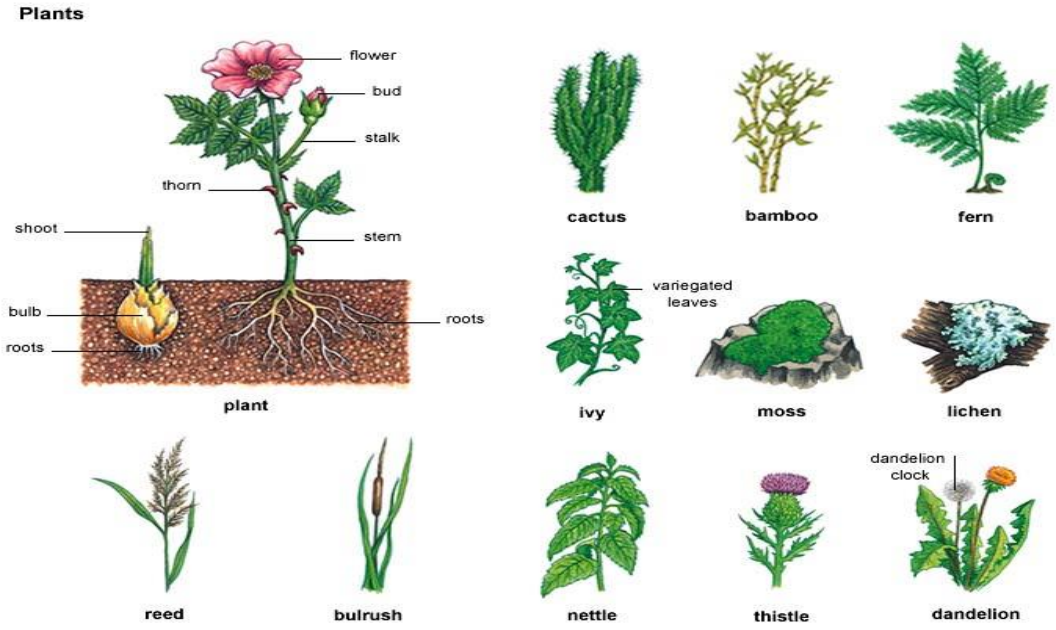


Figure No. 1.1 : Introduction

1.1 BACKGROUND

Plants are really important for the planet and for all living things. Plants provide breathable climate, fuel, medicines, etc. There is a huge flora around the world. Therefore, it is not possible or practical for a botanist or expert to identify all the plant species. Some species are similar, so it takes a long time to distinguish between them. In addition, many plants face the problem of extinction. Therefore, an automatic plant identification system needs to be developed. Such a system is useful not only for general use, but also helpful for experienced botanists and plant ecologists. Leaf identification is an important part of identifying plant species. The leaf forms of the plants are different and each plant has relatively stable characteristics. These characteristics are the starting point for recognizing plants. Many researchers have made efforts to identify plants using the leaves of the plant. They chose it because the leaves are a two-dimensional planar system that is easy to process and accessible compared to other parts of the plant. Image-based methods are considered a good approach to plant identification.

1.2 SIGNIFICANCE

A flora classifier holds significant potential for enhancing gardening experiences and fostering greater appreciation for plant diversity. It empowers gardening enthusiasts to accurately identify and manage plant species within their domestic environments. This tool not only aids in maintaining healthy gardens but also serves as an educational resource, promoting environmental awareness and encouraging sustainable gardening practices. Furthermore, it contributes to citizen science initiatives by gathering data on local flora, supporting conservation efforts, and enriching our understanding of botanical ecosystems.

1.3 PROBLEM STATEMENT

The current paradigm of home gardening is marred by the absence of accessible and efficient tools for plant identification and management. Traditional methods predominantly rely on manual observation and consultation of reference materials, which can be time-consuming, error-prone, and inaccessible for novice gardeners. This limitation becomes particularly pronounced in the context of diverse plant species commonly found in domestic environments, where accurate identification is crucial for proper care and maintenance.

Moreover, as gardening continues to gain popularity among individuals seeking a closer connection with nature or sustainable food sources, the need for reliable assistance in plant management becomes increasingly evident. Novice gardeners, in particular, often face challenges in differentiating between various plant species and understanding their specific care requirements, leading to suboptimal growth outcomes and frustration.The development of a home flora classifier using machine learning (ML) presents a compelling solution. By leveraging ML algorithms trained on vast datasets of plant images and associated metadata, such a classifier can offer automated and accurate identification of plant species based on visual characteristics.

This would empower gardening enthusiasts of all skill levels to quickly and confidently identify plants within their home environments, facilitating better care and maintenance practices.Furthermore, the integration of ML-based plant classifiers into user-friendly applications or devices would democratize access to plant identification tools, making them readily available to a wider audience. Such tools could include features like personalized plant care recommendations, pest and disease identification, and gardening tips, enhancing the overall gardening experience and fostering a deeper appreciation for plant diversity and environmental stewardship.

1.4 OBJECTIVE

This design aims to achieve the following

- The accurate identification and categorization of plant species based on visual characteristics within domestic environments.
- To Develop a user-friendly interface or application for the home flora classifier, enabling users to easily upload images and receive accurate plant identification results.

1.5 RELEVANCY OF THE PROJECT

A flora classifier using machine learning holds immense relevance for both individuals and communities, offering practical benefits and fostering deeper connections with nature:

For individuals, especially gardening enthusiasts and novice gardeners, the classifier provides a valuable tool for accurately identifying plant species within home environments. This empowers them to better understand and care for their plants, leading to healthier gardens and more fulfilling gardening experiences. Additionally, the classifier promotes botanical education by offering a user-friendly platform for learning about plant diversity and characteristics. Users can explore detailed information about identified plant species, enhancing their knowledge of botany and plant science. Moreover, engaging with the classifier cultivates environmental awareness and stewardship. By accurately identifying and managing plant species, users develop a deeper appreciation for nature and learn about the importance of biodiversity conservation and sustainable gardening practices. Users can exchange tips, experiences, and insights related to plant identification and care, fostering a sense of camaraderie and mutual support within the gardening community. Overall, a home flora classifier using machine learning serves as a valuable resource for individuals seeking to enhance their gardening skills, deepen their understanding of plant life, and contribute to environmental conservation efforts.

CHAPTER 2
LITERATURE SURVEY

2.1 MEDICINAL PLANT IDENTIFICATION IN THE WILD BY USING CNN.

AUTHOR: Trung Nguyen Quoc, Vinh Truong Hoang.

YEAR OF PUBLICATION: 2020

ALGORITHM USED:

Mutual Information Guided Algorithm.

ABSTRACT:

The abstract takes the spotlight for recognizing Vietnamese medicinal plants and achieving the highest accuracy at 88.26%.This success holds promise for advancing the discovery and preservation of valuable medicinal plants, showcasing the potential impact of these approaches in the field.

MERIT:

Efficient feature selection based on relevance to target variable.

DEMERIT:

Sensitivity to dataset size and selection biases.

2.2 PLANT IDENTIFICATION USING MACHINE LEARNING

AUTHOR: Gauri Katiyar, Rahul Chandola, Surjit Kumar.

YEAR OF PUBLICATION: 2021

ALGORITHM USED:

Support vector Machine , Random Forest.

ABSTRACT:

Focuses on digitally identifying plant species through single leaf images, catering to diverse fields like ecology, horticulture, and medicinal applications.

This approach ensures robustness and achieves high accuracy, contributing significantly to plant species recognition using neural networks.

MERIT:

Accurate and efficient plant species recognition from images.

DEMERIT:

Limited accuracy with rare or overlapping plant species.

2.3 ARG CNN: AN ATTENTION BASED NETWORK FOR PLANT

AUTHOR: Min Yuan, Wenyu Zhang, Wei Zhao.

YEAR OF PUBLICATION: 2022

ALGORITHM USED:

Attention-based Recurrent Graph Convolutional Neural Network

ABSTRACT:

This study tackles the issue of low accuracy in plant identification by proposing ARG-CNN. Improving feature discrimination amidst challenges like complex backgrounds and variance within plant classes, proposing ARG-CNN. Improving feature discrimination amidst challenges like complex backgrounds and variance within plant classes.

MERIT:

Enhanced plant identification accuracy through attention-based feature extraction.

DEMERIT:

Potential computational complexity due to attention mechanisms.

2.4 ACCURATE MEDICINAL PLANT IDENTIFICATION IN NATURAL ENVIRONMENT.

AUTHOR : B.Aishwarya , J.Reshma ,G.Sai Vennela.

YEAR OF PUBLICATION : 2022

ALGORITHM USED :

Embedding Mutual Information in a Convolution Neural Network Model.

ABSTRACT :

It enhance automatic medicinal plant recognition by addressing limitations in existing systems and introduces a CNN model infused with mutual information for sample selection, significantly improving accuracy to over 97% .

This advancement bolsters reliability in plant identification, crucial for user safety and marking a substantial leap in accurate and trustworthy plant classification.

MERIT:

Enhanced medicinal plant identification accuracy in natural environments leveraging mutual information in CNNs.

DEMERIT :

Potential challenges in generalizing to diverse natural environments.

2.5 AUTOMATIC PLANT RECOGNITION : A SURVEY OF RELEVANT ALGORITHMS

AUTHOR: Noor Aini Mohd Roslan, Zaidah Ibrahim.

YEAR OF PUBLICATION: 2022

ALGORITHM USED:

K Nearest Neighbour, Artificial Neural Network

ABSTRACT:

This survey reviews state-of-the-art algorithms for automatic plant recognition, categorizing them into traditional computer vision, machine learning, and deep learning approaches. It explores key components like feature extraction, classification methods, and challenges such as illumination variation and intra-class variability. Ethical considerations and future research directions are also discussed.

MERIT:

Unlock the power of automation with our survey of cutting-edge algorithms

DEMERIT:

Limitations may arise from algorithmic accuracy and variability in plant species identification.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The current systems are based on medicinal plants and flowers, and the flower-based identification system gives the top three flower images that are most similar to each other. If their colour is distinct, the accuracy is good. However, if colours are identical, it might be inaccurate to classify the picture. High precision is achieved when identifying medicinal plants, but leaf vein and edge characteristics are not taken into account. It provides a categorization based on their growth habits, such as trees, shrubs, vines, herbs, or succulents. It make classification on the structure of leaf and flower.

3.1.1 Demerits

- Advanced classifiers may involve the collection and processing of sensitive data, such as user-generated images and location information.
- Lack of robustness to variations in leaf appearance, such as changes in lighting, background, or leaf orientation, can hinder the performance of the classifier in real-world scenarios.
- Ensuring data privacy, confidentiality, and compliance with regulations such as GDPR (General Data Protection Regulation) and HIPAA (Health Insurance Portability and Accountability Act) is critical to maintain user trust and protect user rights.
- Machine Learning models trained on a specific set of plant species and environmanetal conditions may struggle to generalize well to unseen species or environments outside the training data distribution

3.2 PROPOSED SYSTEM

The system aims to provide accurate and reliable identification of home-grown plants, Provides cultivation guidelines, care instructions, and detailed insights into the medicinal uses of the identified species, fostering a holistic understanding of home flora. Users can input plant characteristics (leaf shape, color, flower type) to help identify the species from a database. Provides detailed steps on how to plant and propagate different species, including soil type, spacing, and planting season. Information on ideal sunlight, temperature, and humidity conditions for optimal growth. Specific guidelines on watering frequency and types of fertilizers suitable for each plant.

3.2.1Merits

- Empowers users with knowledge about their home-grown plants, promoting sustainable gardening.
- Provides information on the medicinal uses of plants, encouraging natural and holistic health practices.
- Fosters a community of plant enthusiasts who can share knowledge and support each other.
- Warnings about potential side effects and contraindications, ensuring safe usage.
- Alerts and reminders for watering, feeding, and other care activities.

CHAPTER 4
SYSTEM SPECIFICATIONS

4.1 HARDWARE SPECIFICATION

- Processing Power: A Multicore processor (such as Intel Core i5 or higher)
- Memory (RAM): At least 8 GB of RAM
- Storage: Sufficient storage space is needed for storing the dataset, trained models, and associated files. An SSD is recommended for faster data access.
- Graphics Card (Optional): GPU (such as NVIDIA GeForce or Quadro series)

4.2 SOFTWARE SPECIFICATION

- Operating System: Windows, macOS, or Linux platforms.
- Python.
- Deep Learning Frameworks: TensorFlow, PyTorch, Keras.
- Image Processing Libraries: Libraries like OpenCV.

CHAPTER 5

ARCHITECTURAL DESIGN

5.1 SYSTEM ARCHITECTURE

A system architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

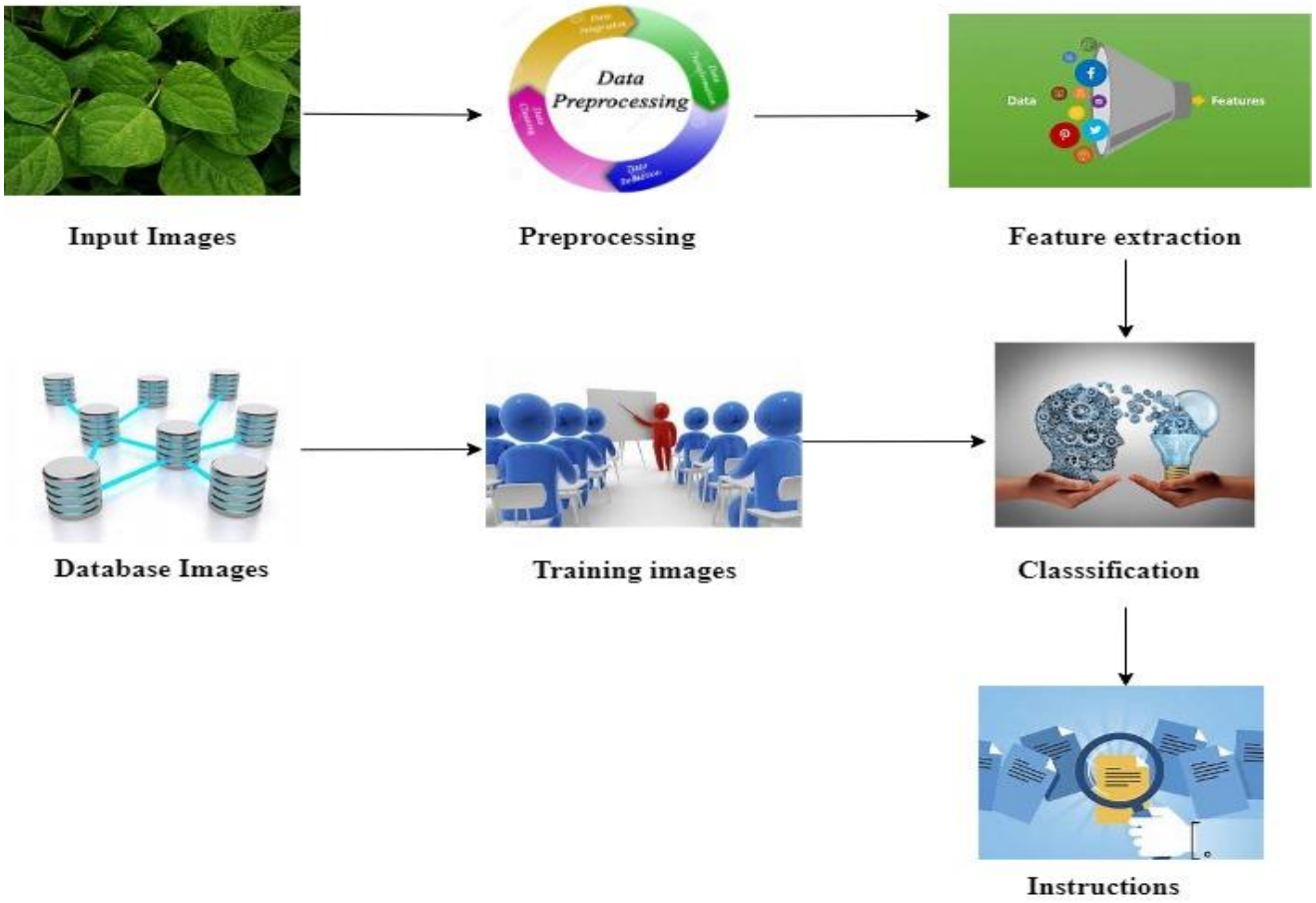
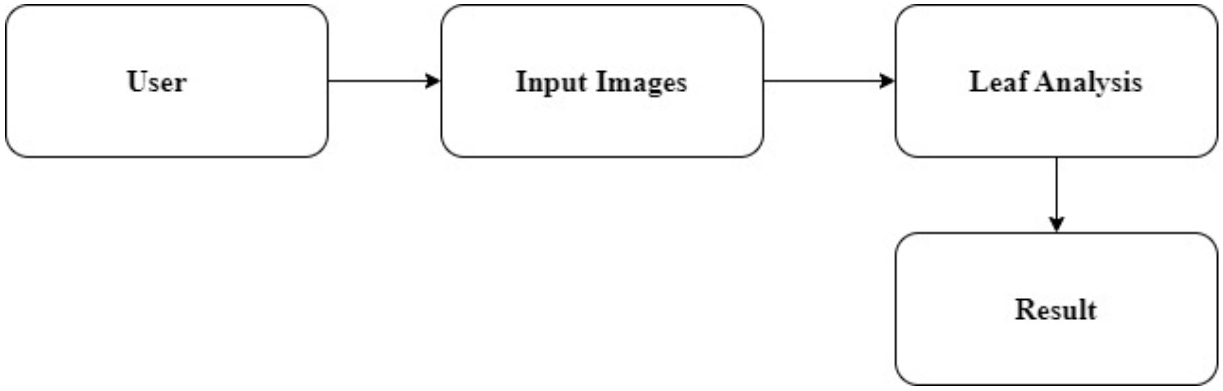


Figure No. 5.1 : System Architecture

5.2 DATA FLOW DIAGRAM

The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.

DFD 0 :



DFD 1:

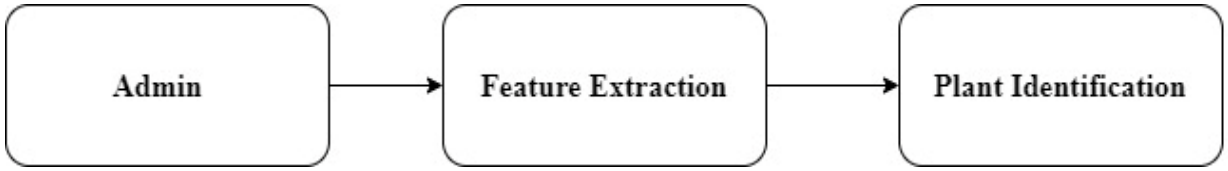


Figure No.5.2 : Data Flow Diagram

5.3 USE CASE DIAGRAM

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms 41 of actors, their goals and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed.

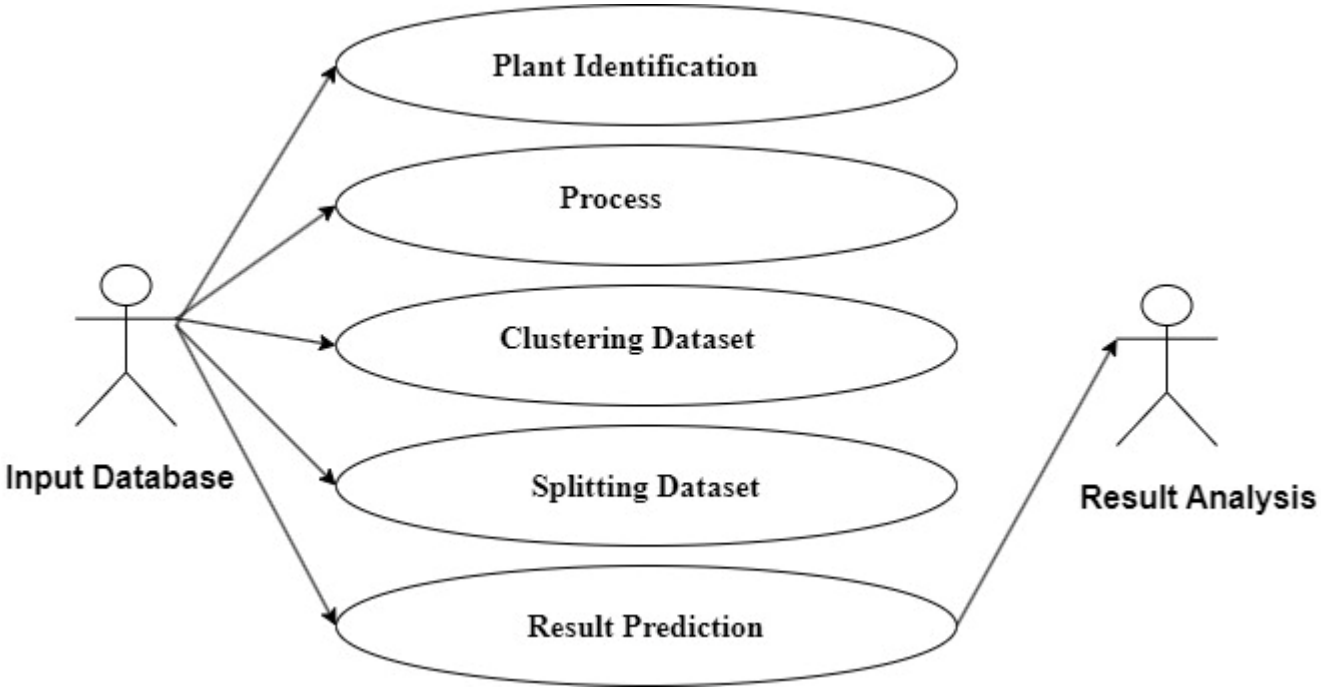


Figure No.5.3 : Use case Diagram

5.4 BLOCK DIAGRAM

A block diagram is a visual representation of a system, process, or concept, illustrating the components and their relationships using blocks (rectangles or other shapes) connected by lines or arrows. Block diagrams are widely used in engineering, business, software design, and various fields to simplify and communicate complex structures and processes.

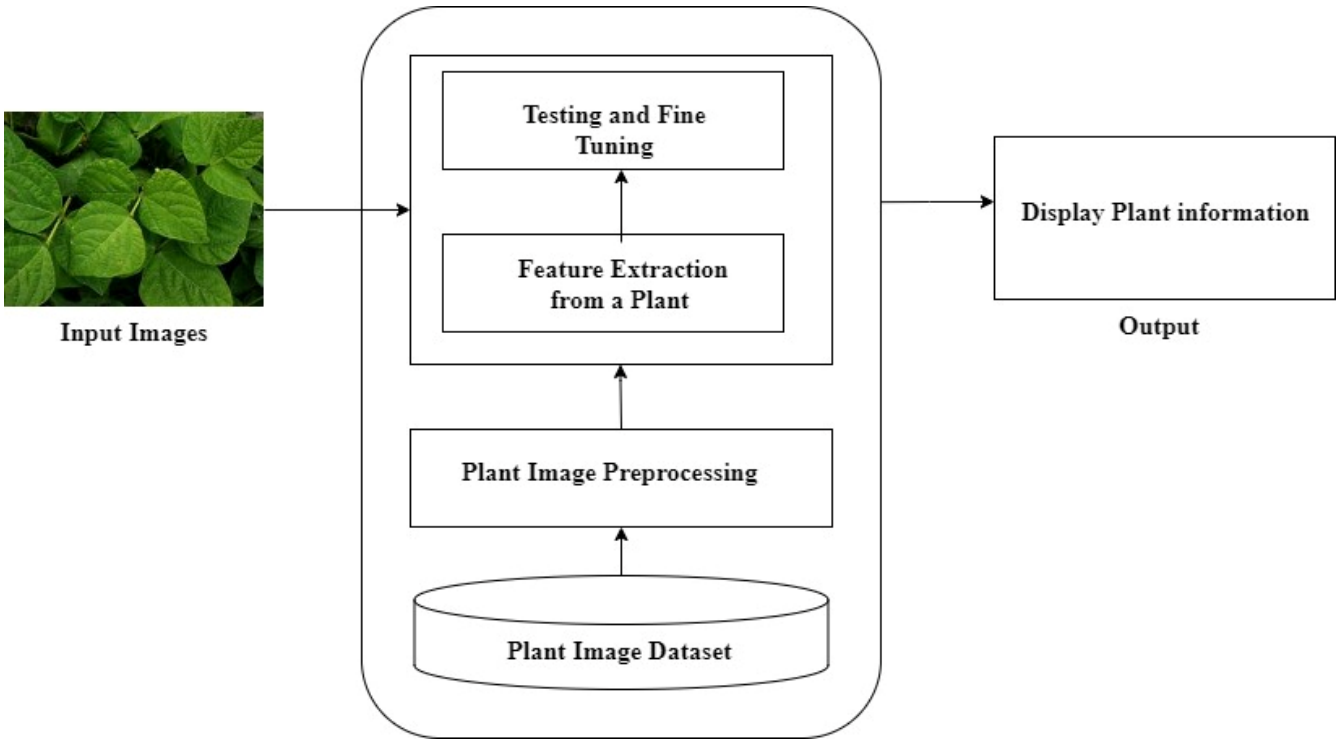


Figure No. 5.4 : Block Diagram

5.5 SEQUENCE DIAGRAM

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

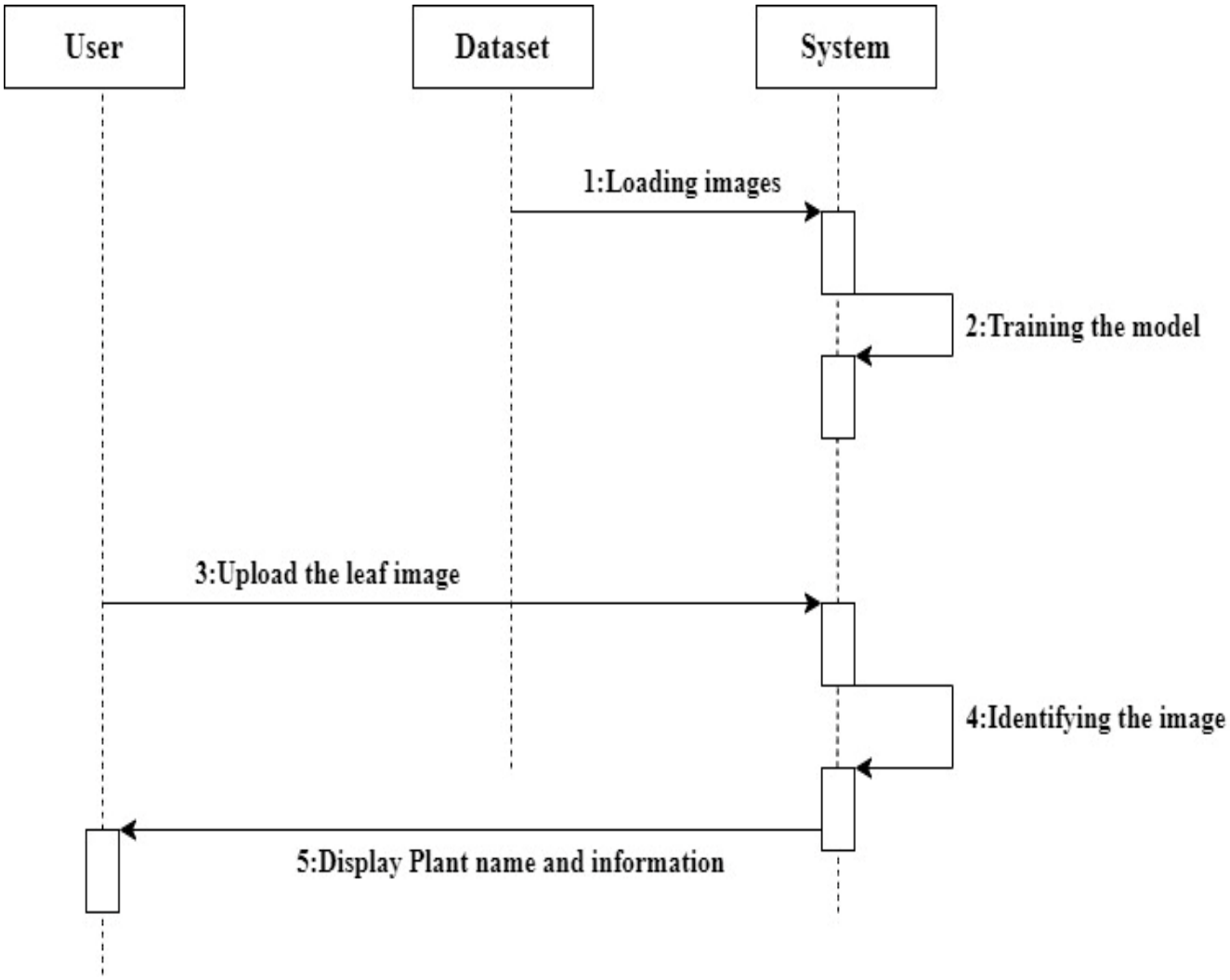


Figure No. 5.5 : Sequence Diagram

CHAPTER 6

MODULE DESCRIPTION

6.1 MODULES

- Data Collection and Storage Module
- Data Preproessing Module
- Model Building and Training Module
- Model Evaluation Module
- Model Deployment Module
- Maintenance and Update Module

6.1.1 DATASET COLLECTION

1. Collect the plant dataset which consists of plant information. A data set is a collection of data.
2. Most commonly a data set corresponds to the contents of a single database table, or a single statistical data matrix, where every column of the table represents a particular variable, and each row corresponds to a given member of the data set in question.

3. Image Dataset : A diverse collection of labeled images for different plant species, sourced from publicly available databases and user contributions.
4. Textual Data : Information on plant care, cultivation guidelines, and medicinal uses, collected from botanical references and gardening resources

6.1.2 DATA PREPROCESSING

Data filtering, is the process of detecting and (or removing) missing records from a record set, table, or database and refers to identifying incomplete, incorrect, inaccurate or irrelevant parts of the data and then replacing, modifying, or deleting the dirty or coarse data.

1. Image Resizing : Standardize image sizes to 224x224 pixels to match the input requirements of the pre-trained models.
2. Normalization : Normalize pixel values to a range of 0 to 1 for consistent model input.
3. Data Augmentation : Apply techniques such as rotation, zoom, flip, and shift to increase dataset diversity and improve model robustness.

6.1.3 MODEL BUILDING AND TRAINING MODULE

1. Model selection

   Pretrained CNN Model :Utilize models like VGG16, ResNet50, and MobileNet for transfer learning, leveraging their pre-trained weights for effective feature extraction.

   Custome Layers :Add fully connected layers on top of the pre-trained models to adapt them for the specific task of plant identification.

2. Model Training

Data Splitup :Divide the dataset into training, validation, and test sets (e.g., 70% training, 20% validation, 10% test).

Training Process :Train the model using the training set, monitor performance on the validation set, and fine-tune hyperparameters for optimal accuracy.

Evaluation :Assess the model on the test set using metrics like accuracy, precision, recall, and F1-score. Analyze the confusion matrix to identify common misclassifications.

6.1.4 DATA CLUSTERING

1. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters).
2. The k-Means Clustering method starts with k initial clusters as specified. At each iteration, the records are assigned to the cluster with the closest centroid, or centre. After each iteration, the distance from each record to the centre of the cluster is calculated.

6.1.5 CLASSIFICATION

Data classification is a diverse process that involves various methods and criteria for Product dataset within a database or repository SVM classification is the process of organizing data into categories for its most effective and efficient use and predict result. This is generally done through a database or business intelligence software that provides the ability to scan, identify and separate data.

6.1.6 DEPLOYMENT

Component diagrams are used to describe the components and deployment diagrams shows how they are deployed in hardware. UML is mainly designed to focus on the software artifacts of a system. However, these two diagrams are special diagrams used to focus on software and hardware component.

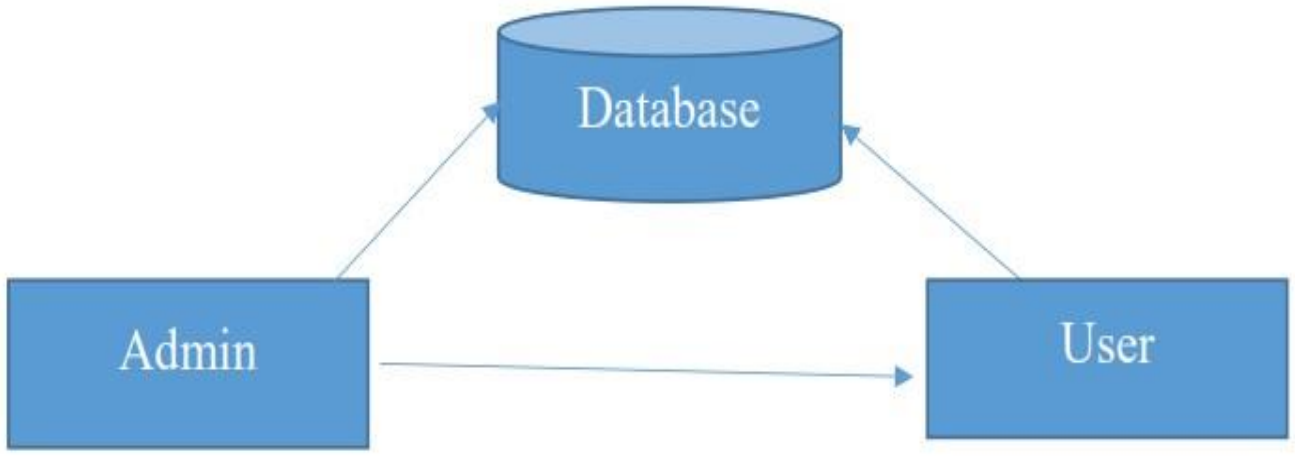


Figure No.6.1.6 Deployment

CHAPTER 7

CONCLUSION AND FUTURE ENHANCE

7.1 CONCLUSION

The "Flora Classifier using Machine Learning" stands out as an innovative solution in plant identification, overcoming limitations of existing systems. Leveraging advanced image recognition, it ensures precise plant identification and addresses user privacy concerns with offline functionality. The system's commitment to providing comprehensive plant information, including medicinal insights, enhances its educational value. With an intuitive interface and user-centric design, the "Flora Classifier using Machine Learning" aims to empower plant enthusiasts, fostering a harmonious connection between users and their cultivated plants. Positioned as a valuable tool for both beginners and their cultivated plants. Positioned as a valuable tool for both beginners and experienced gardeners, it aspires to redefine plant-related applications, promoting sustainable and informed home gardening practices.

7.2 FUTURE ENHANCE

As the project matures, future iterations of the " Flora Classifier using Machine Learning " aims to enhance its capabilities by incorporating user feedback, expanding the plant database, and refining the machine learning model. Moreover, the project envisions community engagement, encouraging users to share their experiences and insights, thus creating a dynamic platform for the exchange of knowledge among home gardeners. By contributing to the collective wisdom of plant enthusiasts, the "Home Flora Classifier" aspires to become a catalyst for the growth of a vibrant and informed community.

APPENDIX 1

SAMPLE CODE

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Home Flora Identification and Care System</title>
    <style>
        body {
            background-image: url('https://www.transparenttextures.com/patterns/leaf.png');
 /* Leaf background pattern */
            background-color: #e0f7e0; /* Light green */
            color: #333; /* Dark grey */
            font-family: Arial, sans-serif;
            margin: 0;
            padding: 0;
        }
        header {
            background-color: #006400; /* Dark green */
            color: #fff; /* White */
            padding: 20px;
            text-align: center;
        }
        nav {
            background-color: #228b22; /* Forest green */
            color: #fff;
            padding: 10px;
            text-align: center;
        }
        nav a {
            color: #fff;
            text-decoration: none;
            padding: 10px 20px;
            margin: 0 10px;
        }
        nav a:hover {
```

```
            background-color: #fff;
            color: #228b22;
            border-radius: 5px;
        }
        main {
            padding: 20px;
        }
        .content {
            background-color: rgba(255, 255, 255, 0.8); /* White with transparency */
            border-radius: 10px;
            padding: 20px;
            margin: 20px 0;
        }
        footer {
            background-color: #006400;
            color: #fff;
            text-align: center;
            padding: 10px;
            position: fixed;
            bottom: 0;
            width: 100%;
        }
        input[type="file"] {
            display: block;
            margin: 20px 0;
        }
        button {
            background-color: #228b22;
            color: white;
            padding: 10px 20px;
            border: none;
            border-radius: 5px;
            cursor: pointer;
        }
        button:hover {
            background-color: #006400;
        }
    </style>
</head>
<body>
    <header>
```

```
        <h1>Home Flora Identification and Care System</h1>
    </header>
    <nav>
        <a href="#">Home</a>
        <a href="#">About</a>
        <a href="#">Services</a>
        <a href="#">Contact</a>
    </nav>
    <main>
        <div class="content">
            <h2>Welcome to our Home Flora Identification and Care System!</h2>
            <p>This system helps you identify different types of indoor plants and provides care tips to keep them healthy.</p>
            <p>Upload an image of your plant to get started!</p>
            <input type="file" accept="image/*" id="upload">
            <button onclick="identifyPlant()">Identify Plant</button>
        </div>
        <div class="content" id="result">
            <h2>Identification Result</h2>
            <!-- Identification results will be displayed here -->
        </div>
        <div class="content" id="care-instructions">
            <h2>Care Instructions</h2>
            <!-- Care instructions will be displayed here -->
        </div>
    </main>
    <footer>
        <p>&copy; 2024 Home Flora Identification and Care System</p>
    </footer>

    <script>
        function identifyPlant() {
            // Placeholder function for plant identification
            // Replace this with actual machine learning model integration
            const resultDiv = document.getElementById('result');
            const careInstructionsDiv = document.getElementById('care-instructions');

            // Placeholder identification result
            resultDiv.innerHTML = `
                <p><strong>Plant Name:</strong> Tomato Plant</p>
                <p><strong>Scientific Name:</strong> Solanum Lycopersicum</p>
```

```
        `;

        // Placeholder care instructions
        careInstructionsDiv.innerHTML = `
            <p><strong>Watering:</strong> Keep the soil moist but not waterlogged. Water when the top 1 inch of soil feels dry.</p>
            <p><strong>Light:</strong> Place in bright, indirect sunlight. Avoid direct sunlight as it can scorch the leaves.</p>
            <p><strong>Humidity:</strong> Prefers higher humidity. Mist the leaves regularly or use a humidifier.</p>
            <p><strong>Temperature:</strong> Keep in a warm room, ideally between 65°F to 75°F (18°C to 24°C).</p>
        `;
    }
  </script>
</body>
</html>
```

REFERENCES :

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APPENDIX 2

SCREENSHOT

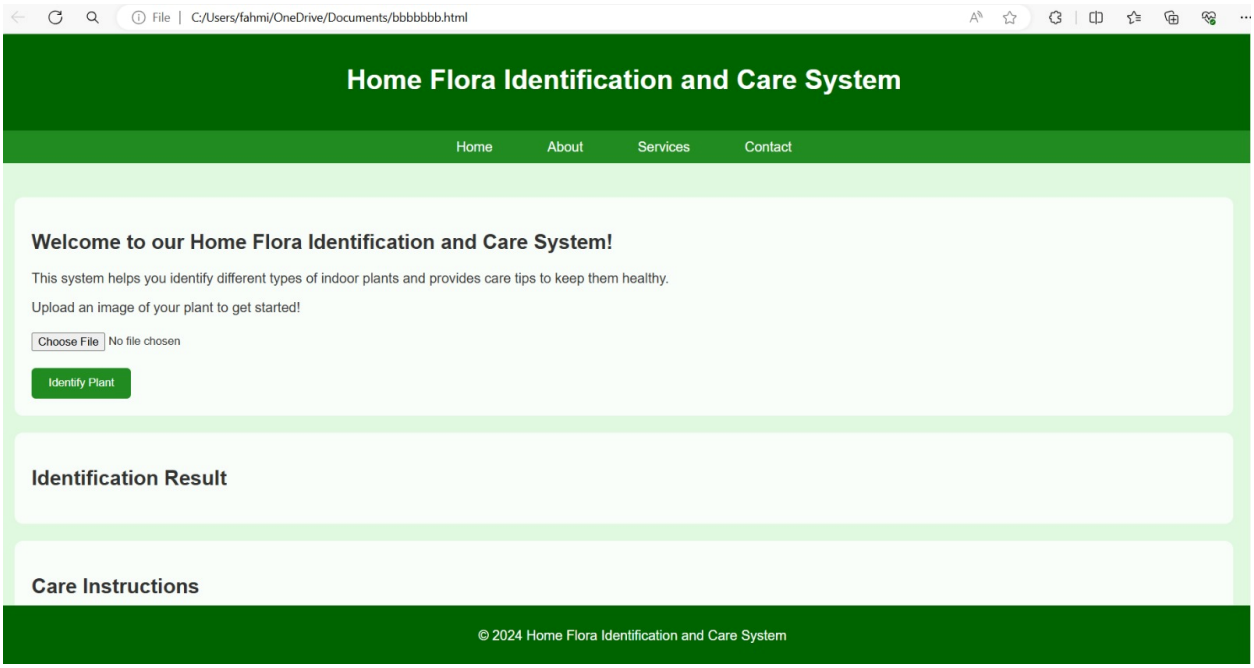

Figure No.A.2.1 : Screenshot 1

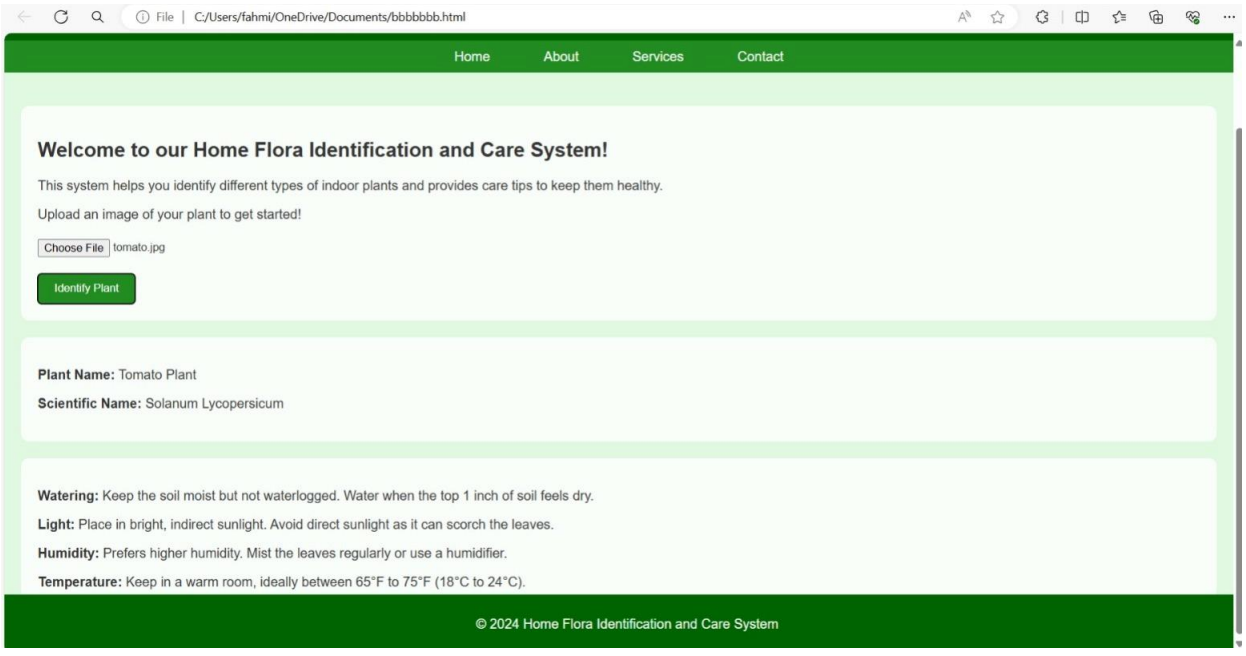

Figure No.A.2.2 : Screenshot 2