HERB VISION: DEEP LEARNING FOR MEDICINAL PLANT LEAF RECOGNITION

Minor project-II report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

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CH.CHANDRAKANTH	(21UECS0117)	**(VTU19678)**
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Under the guidance of
Mr.R.GANESAN,M.Tech.,
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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF COMPUTING

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University Estd u/s 3 of UGC Act, 1956)
Accredited by NAAC with A++ Grade
CHENNAI 600 062, TAMILNADU, INDIA

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CERTIFICATE

It is certified that the work contained in the project report titled "HERB VISION: DEEP LEARNING FOR MEDICINAL PLANT LEAF RECOGNITION" by "SADINENI PAVANI (21UECS0542), CH.CHANDRAKANTH (21UECS0117), SK.MOULALI (21UECS0567)" has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

Signature of Supervisor	**Signature of Professor In-charge**
Computer Science & Engineering	**Computer Science & Engineering**
School of Computing	**School of Computing**
Vel Tech Rangarajan Dr. Sagunthala R&D	**Vel Tech Rangarajan Dr. Sagunthala R&D**
Institute of Science & Technology	**Institute of Science & Technology**
May, 2024	**May, 2024**

DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

SADINENI PAVANI

Date: / /

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Date: / /

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APPROVAL SHEET

This project report entitled ”HERB VISION: DEEP LEARNING FOR MEDICINAL PLANT LEAF RECOGNITION” by SADINENI PAVANI (21UECS0542), CH.CHANDRAKANTH (21UECS0117), SK.MOULALI(21UECS0567) is approved for the degree of B.Tech in Computer Science & Engineering.

Examiners **Supervisor**

Mr.R.GANESAN,M.Tech.,Assistant Professor,.

Date: / /

Place:

ACKNOWLEDGEMENT

We express our deepest gratitude to our respected **Founder Chancellor and President Col. Prof. Dr. R. RANGARAJAN B.E. (EEE), B.E. (MECH), M.S (AUTO),D.Sc., Foundress President Dr. R. SAGUNTHALA RANGARAJAN M.B.B.S.** Chairperson Managing Trustee and Vice President.

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ABSTRACT

The detection of medicinal plants through deep learning techniques represents a transformative approach to botanical identification and classification. Particularly Convolutional Neural Network, this methodology involves training models on diverse datasets of medicinal plant images. By employing transfer learning from pre-trained models or designing custom architectures, the deep learning model learns intricate features that differentiate various plant species. The trained model is then capable of accurately classifying and identifying medicinal plants based on visual characteristics, providing a valuable tool for botanists, researchers, and conservationists.This research presents Herb Vision, a deep learning framework designed for the accurate recognition and classification of medicinal plant leaves. With the growing interest in natural remedies and herbal medicine, the need for reliable identification of medicinal plants is paramount. Herb Vision utilizes CNN to extract discriminative features from leaf images, enabling robust classification performance. The dataset comprises a diverse collection of leaf images representing various medicinal plant species. We evaluate the efficacy of Herb Vision on this dataset, achieving promising results in terms of accuracy and efficiency. The proposed framework demonstrates its potential to support botanical research, pharmacology, and herbal medicine practices by facilitating rapid and accurate identification of medicinal plant species. The development of such the systems requires the careful data duration, model fine-tuning, and ethical considerations to ensure accurate, reliable, and unbiased results in the detection of medicinal plants, contributing to advancements in biodiversity research and sustainable use natural resources.The proposed model also contains an accuracy of 95 percent.Gather a diverse dataset of images of various medicinal plants. Ensure that the dataset includes different angles, lighting conditions, and variations in plant appearance.

Keywords:
Medicinal plants images, Botanical,Convolution Neural Networks,Artificial Neural Networks, Deep Learning,Features of Leaves.

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ANN	Artificial Neural Network
CNN	Convolutional Neural Network
DFD	Data Flow Diagram
DL	Deep Learning
ML	Machine Learning
SVM	Support Vector Machine
UML	Unified Modeling Language

TABLE OF CONTENTS

Chapter 1

INTRODUCTION

1.1 Introduction

The identification and classification of medicinal plants have been integral to various fields, ranging from a traditional herbal medicine to modern pharmaceutical research. Conventional methods of plant identification often rely from the manual expertise, which can be time-consuming and prone to errors. In recent years, the advent of deep learning has provided a promising avenue for automating and enhancing the accuracy of medicinal plant detection. Deep learning, especially CNN, excels at learning complex patterns from large datasets, making it well-suited for image-based tasks. This technological advancement offers the potential to revolutionize the way we identify medicinal plants, providing a more efficient and scalable solution. This paper explores the application of deep learning methodologies in the detection of medicinal plants, aiming to bridge the gap between traditional botanical practices and cutting-edge technology for the benefit of biodiversity conservation, herbal medicine, and pharmaceutical research.

This allows the extract plant to be identified, even if several species share the same structure and characteristics. User can take the photos of plants in the field using the built in camera of the mobile device and analyze them using the installed recognition program to identify species or at least receive a list of possible species, because a single match is not possible. By using the computer-aided plant identification system, non professionals can also participate in this process. Collecting leaves of different medicinal plants in the laboratory and taking photos with a smartphone. The extracts a large number of features from each leaf, such as its length, width, perimeter, area, number of vertices, color, perimeter, and truck area.

1.2 Aim of the Project

To provide Indian doctors with a simple and affordable tool to identify Indian medicinal plants and a portal to estimate the variation of properties of plants with complex traits. This allows the exact plant to be identified, even if several species share the same structure and characteristics.

1.3 Project Domain

This research endeavors to advance the field of medicinal plant identification through the application of deep learning techniques, specifically leveraging convolutional Neural Networks.

The study explores the effectiveness of transfer learning from pre-trained models and the development of custom architectures to discern intricate features that distinguish various medicinal plant species.

1.4 Scope of the Project

To Minimize human error while finding the right plant among a large number of plant species. As a scope, the system will use image processing to identify medicinal plants. It provides information about the medicinal significance of the plant.The 'Herb vision: deep learning for medicinal plant leaf recognition' project encompasses a comprehensive approach towards leveraging deep learning techniques for the recognition of medicinal plant leaves. It involves meticulous data collection, preprocessing, and model selection, followed by rigorous training, validation, and testing phases. The deployment of the trained model into a user-friendly application or platform allows for real-world usage, with a feedback loop to continuously refine its accuracy and expand its database. Integration with botanical databases enhances the user experience by providing additional information about identified plants. Ethical considerations, including data privacy and responsible deployment, are addressed throughout the project, while documentation and potential publication contribute to the advancement of the field. Thus, users will be able to identify the uses of these plants to make a mobile application where information on medicinal plants will be displayed in global and local languages.

Chapter 2

LITERATURE REVIEW

[1] Ali et al., (2020), presented a study on the classification of medicinal plants using an ensemble of deep ANN. The study aimed to develop a reliable and efficient method for classifying medicinal plants that can be used in the pharmaceutical industry. The researchers used a dataset of 12,000 images of 120 different medicinal plants and divided it into training and testing sets. Presents an ensemble-based approach for classifying medicinal plants using deep ANN. The authors discuss the importance of medicinal plants and their various applications in traditional medicine and drug discovery. They propose an approach that involves extracting features from plant images using pre-trained ANN models, and combining the outputs of multiple ANN models using ensemble techniques.

[2]Azadnia et al., (2021),implemented a “Recognition of leaves of different medicinal plant species using a robust image processing algorithm and artificial neural networks classifier” published in the journal of applied research on medicinal and aromatic plants proposes a method for recognizing leaves of different medicinal plant species using a combination of image processing algorithms and ANN.The authors explain the importance of medicinal plants and their potential for use in various fields, including medicine and cosmetics. They propose a method that involves preprocessing the plant images using a series of image processing algorithms, including binarization, edge detection, and segmentation, and then using the resulting features as input to an ANN classifier..

[3] A. Hassan et al., (2021), presented a study on A Web-Based Medicinal Plant Identification System using Hybrid Deep Learning Techniques.international journal of advanced computer science and applications,it presents a web-based system for identifying medicinal plants using hybrid deep learning techniques. The authors emphasize the importance of identifying medicinal plants for various reasons, including drug discovery, conservation, and sustainable use. They propose a hybrid approach

that combines ANN and SVM for plant identification

[4] Bisen et al., (2021), propsed a “Deep Artificial Neural Network based plant species recognition through features of leaf” presents a novel approach to plant species recognition using deep ANN.The paper explores the potential of using leaf features for plant species recognition, which is a challenging problem due to the large number of plant species and the high intra-class variability.The paper starts with an overview of the related work in plant species recognition and highlights the limitations of the existing approaches. Bisen then proposes a new approach based on deep ANN that can automatically extract relevant features from plant leaf images. The proposed approach consists of three main stages: preprocessing, feature extraction, and classification.

[5] Gutierrez et al., (2022), implemented a “A web-based plant identification system using artificial neural networks” published in the international journal of advanced computer science and applications in presents a web-based system for plant identification using ANN.The authors discuss the importance of plant identification for various applications, including agriculture, ecology, and biodiversity conservation. An exsisting ANN-based approach that involves preprocessing the plant images, training a ANN model, and using the model for plant identification through a web-based interface.

[6] N. Hussain et al., (2021), proposed a “Medicinal plant identification using machine learning techniques which provides a comprehensive review of the use of machine learning techniques for medicinal plant identification”.The authors first introduce the importance of medicinal plants and their potential applications in various fields, including medicine, agriculture, and industry. They then provide an overview of different machine learning techniques, including supervised, unsupervised, and deep learning approaches, and discuss their potential for medicinal plant identification.

[7] K. Pushpanathan, et al., (2020), implemented a “Machine Learning in Medicinal Plants Recognition” which provides a comprehensive review of the current state-of-the-art machine learning techniques for medicinal plants recognition.The authors

first discuss the importance of medicinal plants and their potential for use in various fields, including medicine, food, and cosmetics. They then provide an overview of the different machine learning techniques that have been used for medicinal plant recognition, including deep learning, support vector machines, random forests, and k-nearest neighbors.

[8] M. A. Abdulghani et al., (2021), developed a ”Web-based System for Medicinal Plant Identification Using Deep Learning” published in the journal of king saud university-computer and information sciences in presents a web-based system for identifying medicinal plants using deep learning.The authors emphasize the importance of identifying medicinal plants for various purposes, including traditional medicine, drug discovery, and conservation. They propose a system that involves capturing images of the plant using a smartphone or digital camera, uploading the image to a web-based platform, and using deep learning algorithms for plant identification.

[9] Oluwafemi et al., (2022), implemented a “Recent Advances in the Detection of Medicinal Plants and Their Bioactive Compounds” published in the journal of ethnopharmacology in provides a comprehensive review of recent advances in the detection of medicinal plants and their bioactive compounds.The authors begin by discussing the importance of medicinal plants in traditional and modern medicine, as well as the challenges involved in their identification and characterization. They then review various techniques for plant identification and bioactive compound detection, including chromatography, spectroscopy, and mass spectrometry.

[10] Q. T. Nguyen and V. T. Hoang, ”Medicinal Plant identification in the wild by using CNN,” in 2020 proposed a method for medicinal plant identification in the wild using CNN. They presented their findings at the 2020 international conference on information and communication technology convergence. The study focuses on utilizing CNNs, a type of deep learning model, for recognizing medicinal plants in their natural habitat. This research contributes to the field of computer vision applied to biodiversity conservation and medicinal plant research.

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

Agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. This research presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. It also covers survey on different diseases classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease is done by using genetic algorithm.

3.2 Proposed System

The proper identification of plant species has major benefits for a wide range of stakeholders ranging from forestry services, botanists, taxonomists, physicians, pharmaceutical laboratories, organisations fighting for endangered species, government and the public at large. Consequently, this has fueled an interest in developing automated systems for the recognition of different plant species. A fully automated method for the recognition of medicinal plants using computer vision and deep learning techniques has been presented.Herb Vision introduces a cutting-edge solution to the complex task of identifying medicinal plants through their leaves. In deep learning particularly CNN, the system offers an innovative approach to automate the recognition process. Through meticulous preprocessing and fine-tuning of pre-trained models, the system achieves exceptional accuracy and robustness in classification tasks.

3.3 Feasibility Study

3.3.1 Economic Feasibility

•Very high levels of readily available information of medicinal plant.
• Providing information of medicinal plant as well as pousionus plant.
• Very interactive user experience.
• Providing a lesser work environment.
• Providing a list of availability of ayurvedic plant.
• Providing medicinal use of that plant.
• Easiest way to scan and get details of any plan.

3.3.2 Technical Feasibility

The scanning and getting information of plant would have the option to save time and endeavors of representatives of the humankind. In that manner, some data are accomplished. The reasonableness of getting results alongside its automation would be more than what the manual path does from it. The investigates that are engaged with this task would go through a similar interaction, connected at the hip. As the system keeps on creating, the scientists will be moreover, checking likewise of the product and the equipment conditions ought to be an absolute necessity in light of the fact that the creating of the system is reliant upon those things. The analysts would foster the system without fail and executing all the discoveries that they have.

3.3.3 Social Feasibility

This system would likely enable the client to interact with the web application and get all the details of any plant at anytime. It is expected upon the implementation that it would make a gradual change in terms of the fast way to acquire feed-backs, suggestions.Firstly, the system addresses a pressing need in the fields of botany, herbal medicine, and biodiversity conservation. By providing an efficient means of identifying medicinal plants through their leaves, Herb Vision empowers researchers, botanists, and herbalists with a valuable tool for species recognition, thereby facilitating the exploration and utilization of natural remedies. This contributes to the preservation of traditional knowledge systems and indigenous practices, fostering cultural diversity and promoting holistic approaches to healthcare.

3.4 System Specification

3.4.1 Hardware Specification

• DEVICE NAME - LAPTOP - INSPIRON3501
• PROCESSOR - Intel(R) Core(TM) i5-1035G1 CPU @ 1.00GHz 1.19 GHz
• EDITION - Windows 11 Home
• SYSTEM TYPE - 64-bit operating system, x64-based processor
• OS BUILD - 19043.1165

3.4.2 Software Specification

Install Python on your computer system 10
1. Install tensorflow, Numpy, OpenCV,Keras,etc.,
2. Download the Image Detection model file Steps to be followed.
3. Download and install Python version 3 from official Python Language website.
4. Install the following dependencies using pip.

3.4.3 Standards and Policies

Colab is a free and open-source distribution of the Python and R programming languages for scientific computing, that aims to simplify package management and deployment. The distribution includes data-science packages suitable for Windows, Linux, and macOS. Libraries we use.
1.Numpy
2.Tensor Flow
3.Open CV
4.Keras
A more general definition given by Arthur Samuel is "Machine Learning: the field of study that gives computers the ability to learn without being explicitly programmed". They are typically used to solve various types of life problems. In the older days, people used to perform Machine Learning tasks by manually coding all the algorithms and mathematical statistical formula. It has become very much easy and efficient compared to the olden days by various python libraries, frameworks, and modules. Today, python is one of the most popular programming languages for this task and it has replaced many languages in the industry, one of the reason is its

vast collection of libraries.

Custom Vision Service :

Cloud services such as the custom vision service are well suited for Object Classification Problems where there is limited training data. This is the simplest methodology to attempt.In our investigations, the service performed the best on our dataset but struggled to scale to multiple policies and detect persistent edge cases.

CNN / **Transfer Learning** :

CNN Transfer learning on pre-trained models such as ResNet or Inception works best with midsize datasets that share similar properties with ImageNet categories. Note if you have a large dataset with at least tens of thousands of samples it may be worthwhile retraining all the layers in a model. of the methodologies we investigated transfer learning performed the worst for our complex classification scenario.

ANN/Artificial Neural Networks:

After species identification, the corresponding tags will be converted into keywords in different languages to be searched in different reference sources for relevant information related to medicine. Information retrieval will be developed by algorithms based on artificial neural networks (ANN) to improve the quality of content that users expect. Through the continuous learning approach, the system will reduce errors and increase efficiency.

Images are captured by cameras and transmitted to the system for further image processing. During the initial training process, if there are no plant species in the database. Therefore, the system must be trained by providing labels if the corresponding labels are not found in the dataset where the image were captured. This mechanism must be realized by a supervised learning algorithm. The system has pre-processed the image to improve image quality And will generate a grayscale version of the image for classification purposes.This can be done using TensorFlow framework mechanisms. A large number of characteristics are extracted from each leaf, such as its length, width, perimeter and area, number of vertices, color, perimeter and area of the trunk. Various derived characteristics are then calculated from these characteristics. These derived features were analyzed using a 10-fold cross validation technique with a random forest classifier. The algorithm is used to identify plant species through learning capabilities on pre-processed images.

Chapter 4

METHODOLOGY

4.1 Architecture of Medicinal Plant Leaf Recognition

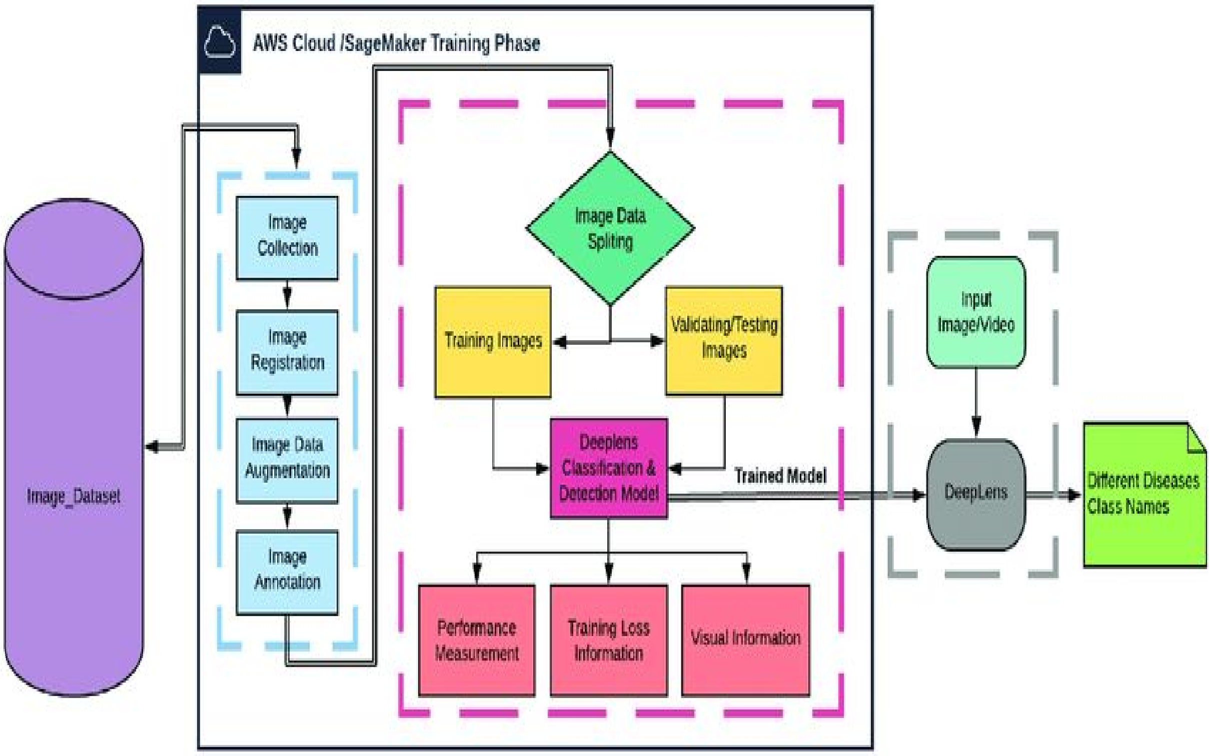

Figure 4.1: **Architecture Diagram of Medicinal PLant Leaf Recognition**

The Figure 4.1 shows the general architecture diagram for the detection of medicinal plants using a web application typically involves several components.Firstly, there is a front-end component, which includes the user interface for the web application. This is the part that the user interacts with, where they can input images of medicinal plant leaves or other relevant features, and receive feedback on the identified plant species. This component typically involves several sub-components, including an image processing module that pre-processes the input images to enhance the quality and remove noise, a machine learning that performs the actual plant species identification, and a database that stores the training data.The machine learning is trained using a large dataset of labeled images of medicinal plant leaves.

4.2 Design Phase

4.2.1 Data Flow Diagram

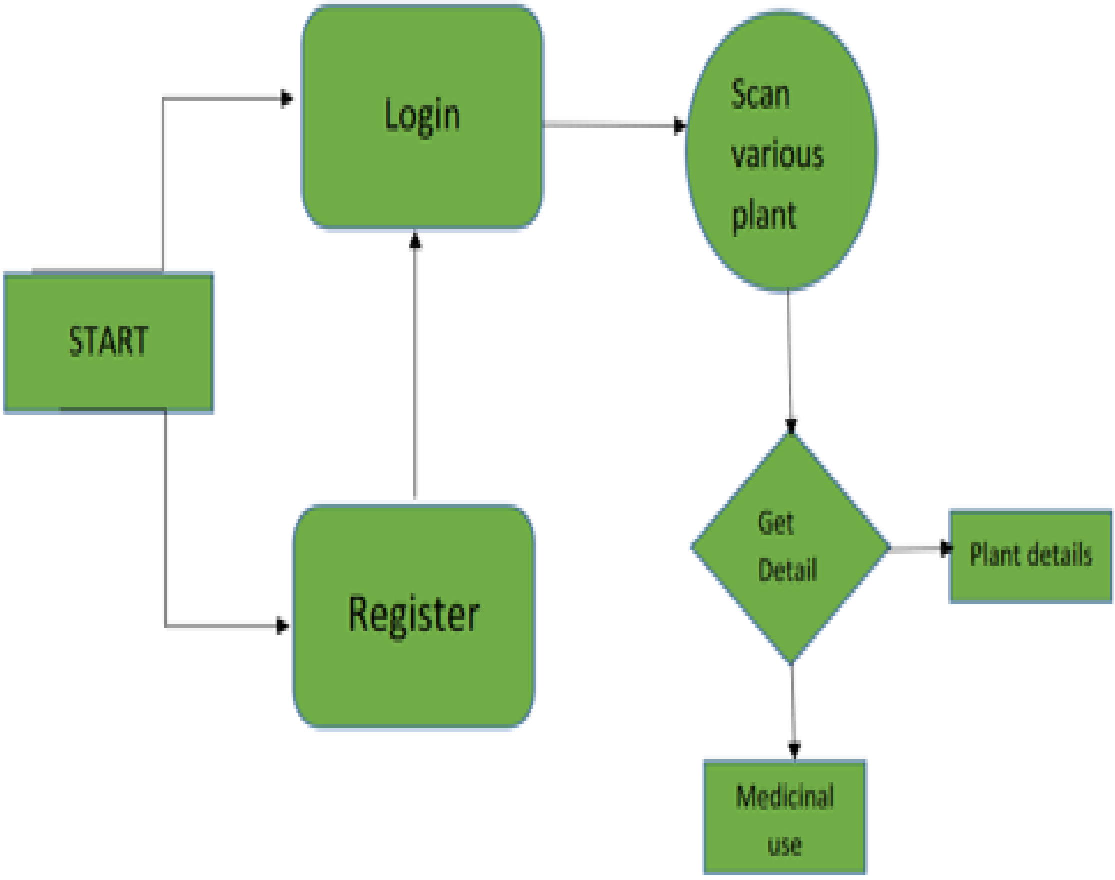

Figure 4.2: **Data flow Diagram**

The Figure 4.2 depicts the DFD is a graphical representation of the flow of data within a system or process. In the context of a web application for the detection of medicinal plants, a DFD can be used to illustrate how data flows through the various components of the system.The DFD typically consists of four main components: data sources, processes, data storage, and data destinations.The processes would include the various steps involved in identifying the plant species, such as preprocessing the images, feature extraction, and classification using machine learning algorithms.

4.2.2 Use Case Diagram

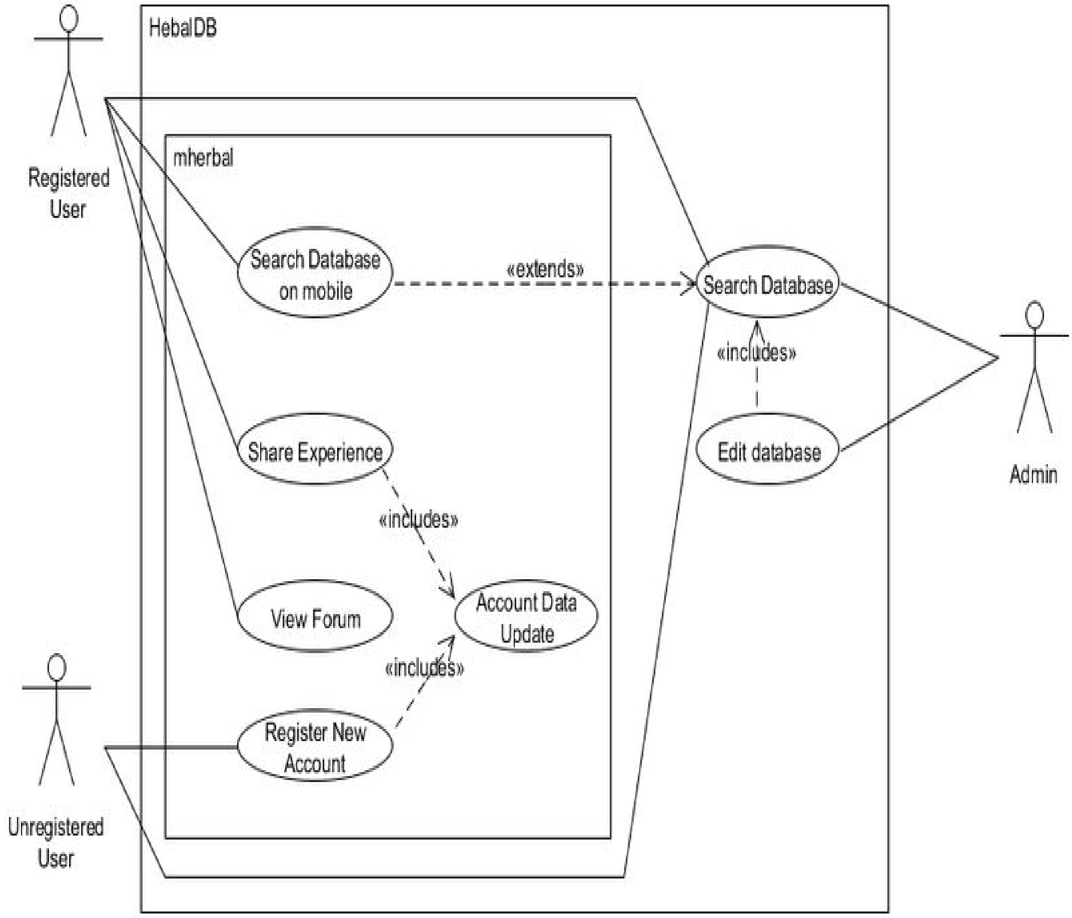

Figure 4.3: **Use case diagram**

The Figure 4.3 illustrates a A use case diagram for the detection of medicinal plants using a web application can help to illustrate the different interactions between the system and its users. A use case diagram is a graphical representation of the system's functionality and its interactions with external actors or users.In this use case diagram, the system is the web application that is designed to identify medicinal plants based on leaf images. The external actors or users of the system include the plant collectors or users who want to identify the medicinal plants.The diagram can be divided into two main parts: the user side and the system side. The user side includes the actors and their interactions with the system, while the system side includes the use cases that describe the system's functionality.

4.2.3 Class Diagram

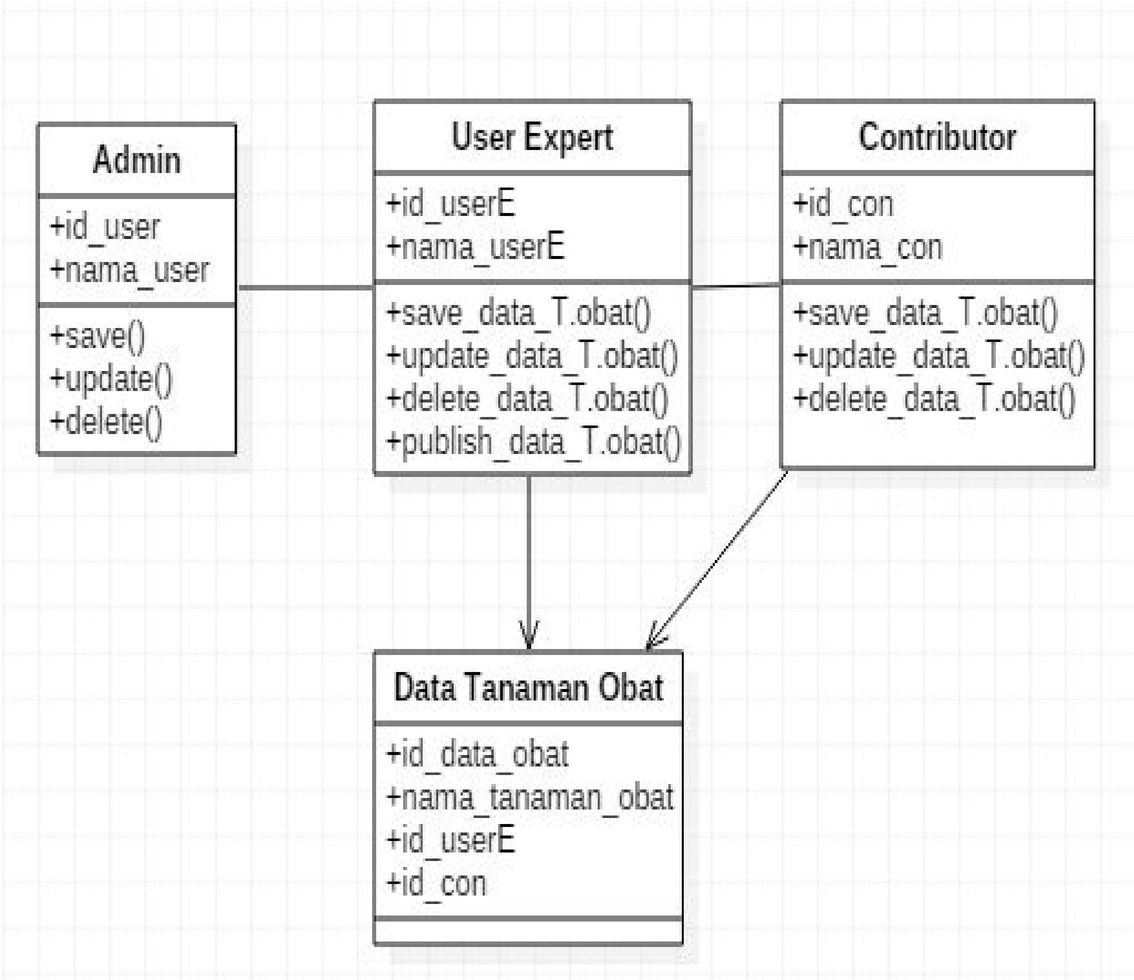

Figure 4.4: **Class Diagram**

This Figure 4.4 illustrates a class diagram is a type of UML diagram that is used to represent the structure of a system's classes, their attributes, methods, and relationships with other classes. In the context of a web application for the detection of medicinal plants, a class diagram would typically include classes such as:

Plant Detector: This class represents the main application and contains attributes such as the plant database.

Plant: This class represents the different medicinal plant species and contains attributes such as plant name, description, and image, medicinal uses.

Image Recognition: This class represents the image processing component of the application and contains methods for processing images, extracting features.

4.2.4 Sequence Diagram

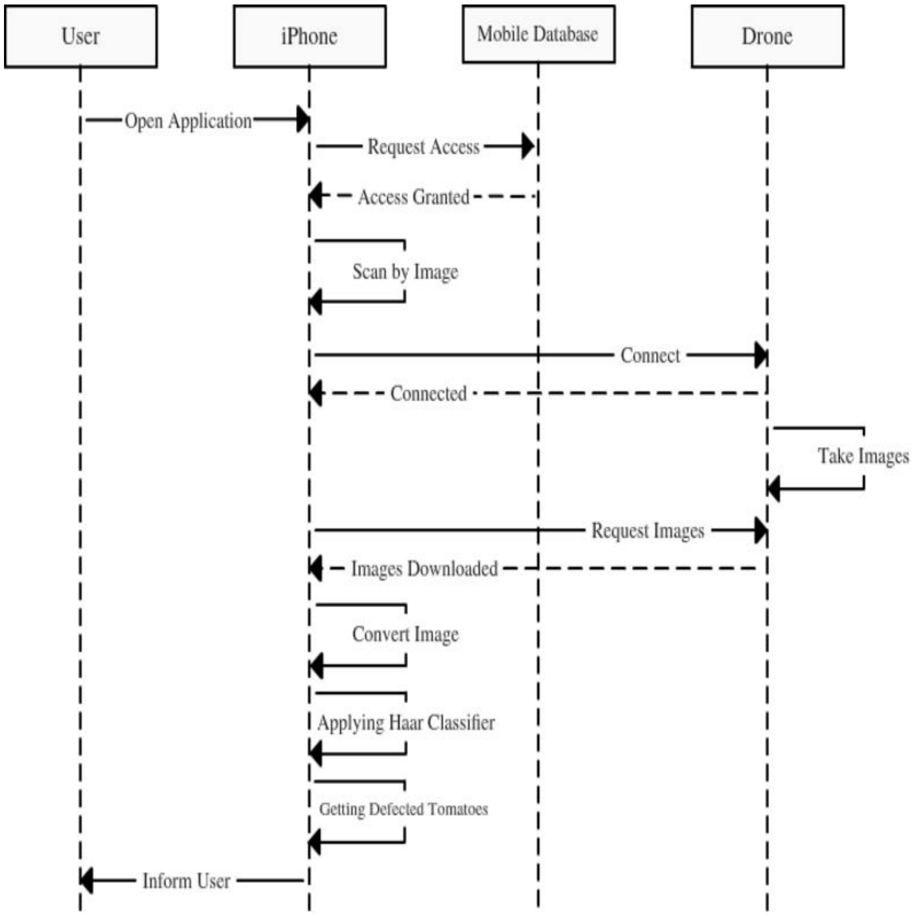

Figure 4.5: **Sequence Diagram**

This Figure 4.5 illustrates a sequence diagram is a type of UML diagram that represents the interactions between different objects in a system over time. In the context of detecting medicinal plants using a web application, a sequence diagram would illustrate the flow of events and actions that occur in the system.The sequence diagram would typically begin with a user accessing the web application to detect a medicinal plant. The user would input an image of the plant or its leaves, which would then be processed by the system.The sequence diagram would show the different components of the system interacting with each other to perform the detection process. This might include the image processing module, which would analyze the input image and extract features such as color and texture.

4.3 Enhanced CNN Algorithm

1.Data Collection:
Gather a diverse dataset of images of medicinal plant leaves. These images should cover various species, angles, lighting conditions, and backgrounds. Annotate the dataset with labels indicating the species of each plant leaf.
2.Data Preprocessing:
Resize all images to a uniform size. Normalize pixel values to a common scale (typically 0 to 1).
3.Model Selection:
Choose a deep learning architecture suitable for image classification tasks. CNN are commonly used for this purpose due to their ability to learn hierarchical features.
4.Model Training:
Split the dataset into training, validation, and testing sets. Tune hyperparameters such as learning rate, batch size, and regularization strength to optimize performance. Monitor the model's performance on the validation set to prevent over fitting.
5.Evaluation:
Evaluate the trained model on the testing set to assess its performance. Metrics such as accuracy, precision, recall, and F1 score can be used to quantify performance.
6.Deployment:
Once satisfied with the model's performance, deploy it in a production environment. Integrate the model into an application or system where users can upload images of medicinal plant leaves for classification.
7.Optional Enhancements:
Implement techniques like ensemble learning or model distillation to further improve performance. Explore methods for inter pretability to understand how the model makes predictions, especially in critical applications like medicinal plant recognition.

4.4 Module Description

4.4.1 Data Acquisition Module

This module acquires data from various sources, such as cameras, to monitor the leaf.This module may include hardware components such as cameras, as well as software components for managing and controlling the acquisition process.The data acquisition module for herb vision, particularly for deep learning-based medicinal plant leaf recognition, is a critical component in building an effective recognition system. This module encompasses a systematic approach to collecting, organizing, and annotating data essential for training the recognition model. Firstly, it involves defining the specific requirements of the dataset, including the targeted medicinal plant species and imaging conditions. Subsequently, data collection efforts span a variety of sources, ranging from online repositories to real-world field surveys, ensuring a diverse and representative dataset. Annotation of collected images with corresponding species labels is a pivotal step, often requiring expert knowledge or crowd sourcing for accuracy.

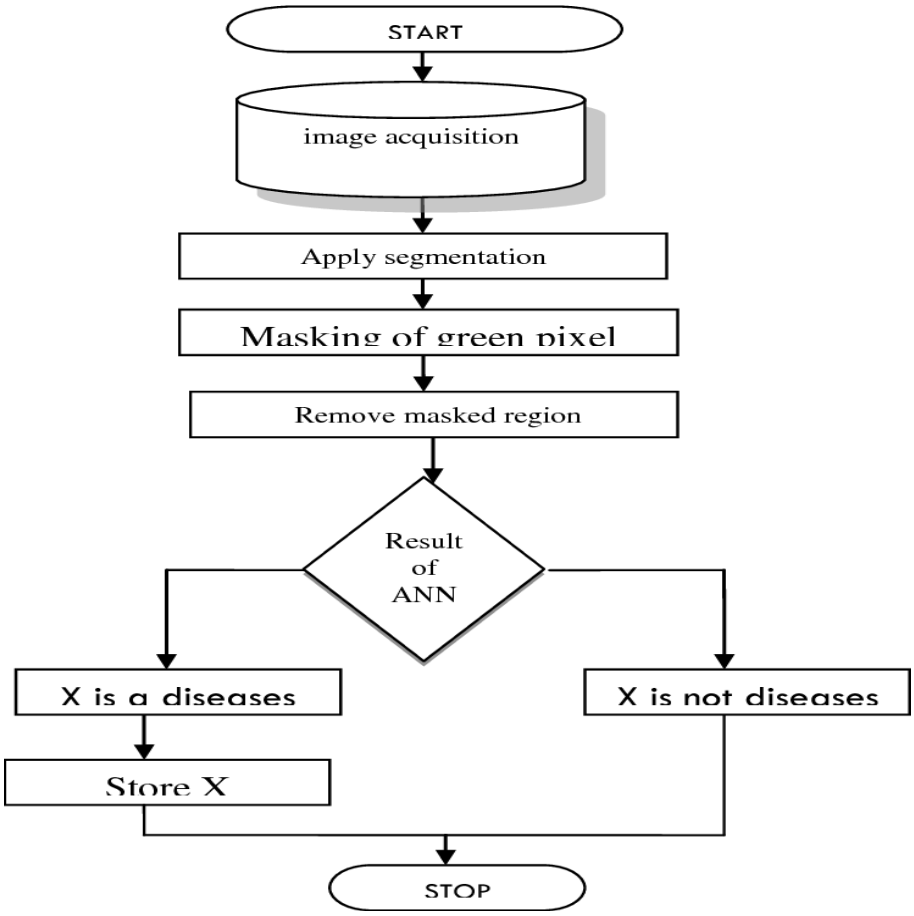

Figure 4.6: **Data Acquistion**

4.4.2 Pre-processing Module

This module preprocesses the data acquired by the data acquisition module, removing excess part of image and artifacts from the image to improve the accuracy of the leaf. The pre-processing module can include several steps, such as image resizing, normalization, and filtering. Image resizing is used to standardize the size of the input images, which can vary significantly in size and aspect ratio. This step is important to ensure that the image features are represented consistently across all images. Normalization is another important pre-processing step that involves adjusting the brightness and contrast of the image to reduce the effects of lighting variations. This helps to enhance the features of the plant leaves and improve the accuracy of the detection system. Filtering is another important pre-processing step that can be used to remove noise from the image and enhance the edges and contours of the plant leaves.The preprocessing module for herb vision, particularly in the context of deep learning-based medicinal plant leaf recognition, plays a crucial role in preparing raw image data for effective model training. This module follows a systematic approach aimed at enhancing the quality and suitability of the input data for neural network processing. Normalization of pixel values follows, standardizing them to a common scale to facilitate convergence during training. Data augmentation techniques are then applied to introduce variability and robustness into the dataset, encompassing transformations such as rotation, flipping, scaling, and noise addition.

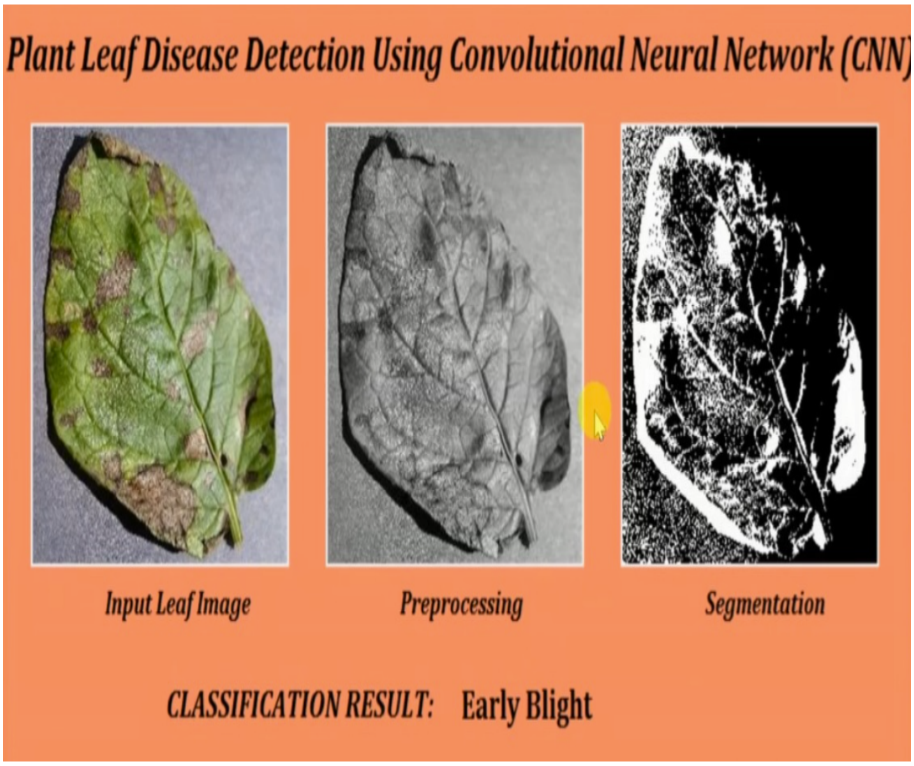

Figure 4.7: **Preprocessing**

4.4.3 Artificial Neural Networks Module

A detection of medicinal plant using CNN typically consists of several modules that work together to capture image input, preprocess the data, analyze it using a

CNN model, generate leaf name medicinal/non-medicinal when necessary, and store relevant data. Additional modules may also be included for configuration settings and overall monitoring of the system.These modules work together to create a robust and effective system for finding the leaf . The image input and preprocessing modules are responsible for collecting and preparing the data, while the CNN model module uses advanced algorithms to analyze the data and detect signs of leaf.The ANN module for herb vision, specifically tailored for deep learning-based medicinal plant leaf recognition, is pivotal in constructing a robust recognition system. At its core lies the design and training of a neural network architecture adept at processing and classifying complex visual data.Evaluation on the testing set provides insights into the model's generalization capabilities, assessed through metrics like accuracy. Fine-tuning and optimization further refine the model, potentially leveraging transfer learning to capitalize on pre-existing knowledge. Once validated, the trained model is deployed for real-world herb vision applications, integrating seamlessly into systems where users can submit images for plant leaf classification. Continuous monitoring and periodic updates ensure the model remains effective in recognizing medicinal plant leaves accurately and reliably.

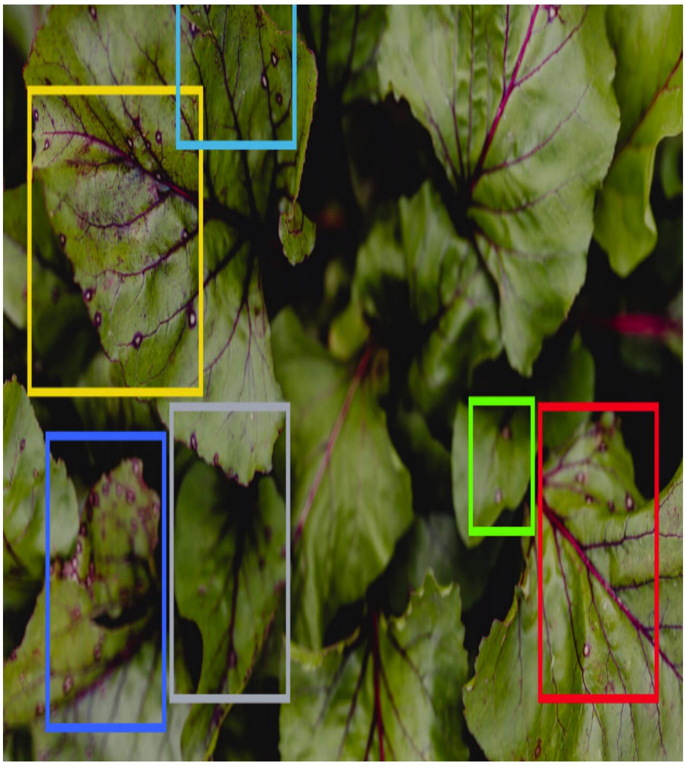

Figure 4.8: **Artificial Neural Network**

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

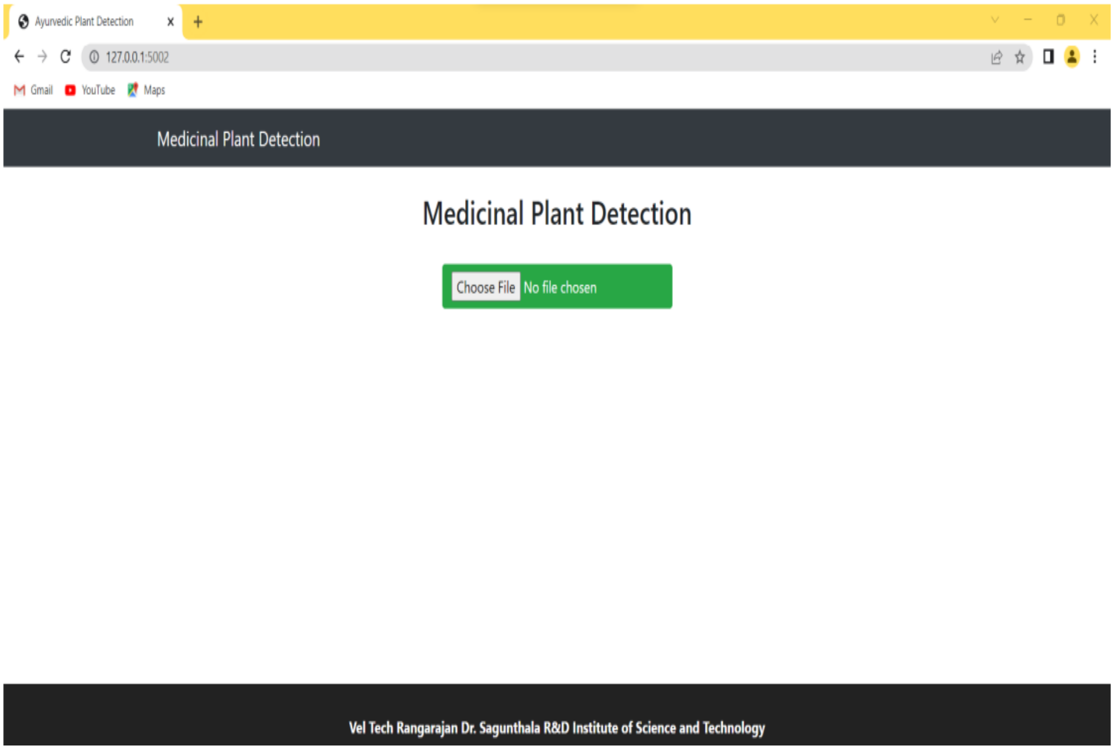

Figure 5.1: **Input Image of Medicinal Leaf**

The Figure 5.1 depicts that the link which will be provided after executing the prescribed code, After pasting the link at the chrome the screen will be displayed by "choose a file" description so that the required photo copy of a medicinal plant will be selected from here an then by choosing appropriate picture of the medicinal plant our required prediction will be displayed.

5.1.2 Output Design

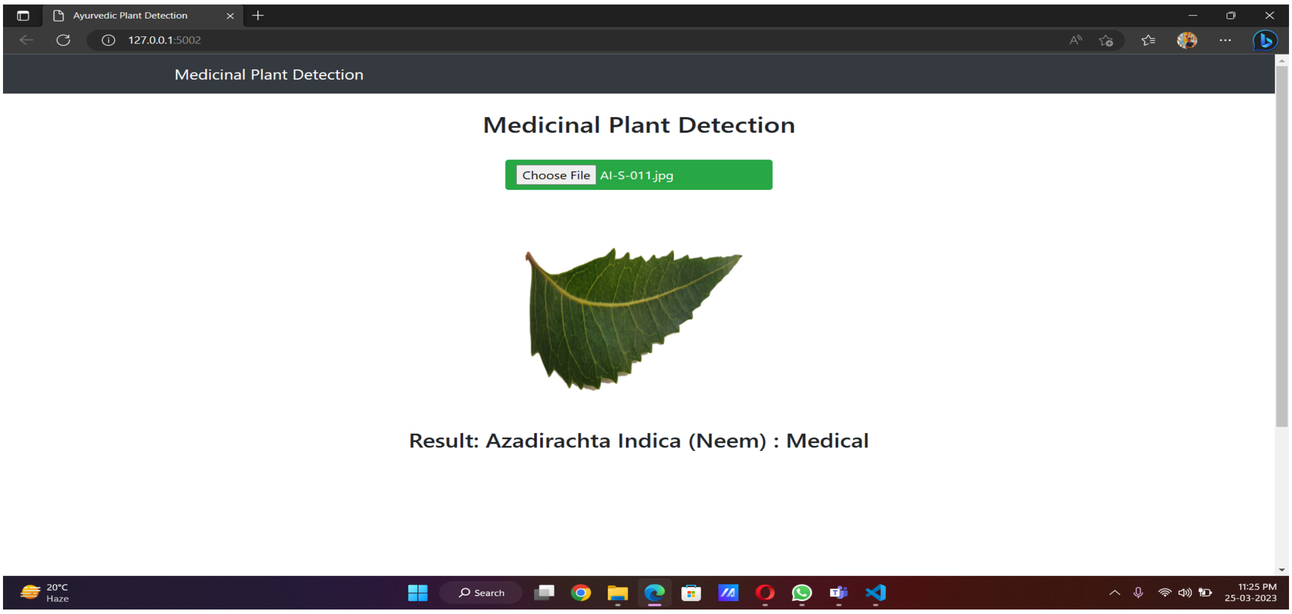

Figure 5.2: **Output Image of Medicinal Leaf:Neem**

The Figure 5.2 depicts the output image of Leaf and describes whether the leaf is Medicinal or Non-Medicinal.

5.2 Testing

Testing process is a process of verifying system to identify any errors in the code and checking accurate results.

5.3 Types of Testing

5.3.1 Unit Testing

The detection of medicinal plants through deep learning involves the application of advanced neural network techniques, particularly CNN, to analyze and classify images of plant species with therapeutic properties. The process begins with the collection of a diverse dataset containing well-labeled images of various medicinal plants. These images undergo preprocessing steps such as resizing, normalization, and augmentation to enhance the dataset's quality and diversity. A suitable deep learning model, often based on pre-trained architectures like ResNet or Inception, is chosen and fine-tuned using the medicinal plant dataset.

5.3.2 Integration Testing

The integration testing phase for the detection of medicinal plants using deep learning is a crucial step in ensuring the seamless functioning of the entire system. This phase involves validating the interactions and compatibility of different components, such as the deep learning model, image processing modules, and any external systems, in an integrated environment. Testing scenarios may include feeding the model with various types of images, assessing its response to diverse environmental conditions, and evaluating its performance in real-world situations. Integration testing aims to uncover potential issues related to data input, model output, and the overall system behavior. It also ensures that the deep learning model is correctly integrated into the larger application infrastructure.

5.3.3 Test Result

All above test cases passed. No faults were encountered.

5.3.4 Functional Testing

Functional testing is a type of software testing that involves testing the functionality of a system or application to ensure that it meets the specified requirements. In the detection of medicinal plants, functional testing can be used to test the functionality of the web application and the accuracy of the plant detection algorithm.Functional testing in the detection of medicinal plants can be performed at various stages of the development process.

User interface testing: This involves testing the user interface of the web application to ensure that it is user-friendly and intuitive.Testers can use functional testing techniques such as usability testing, exploratory testing, and acceptance testing to ensure that the user interface meets the user's expectations.

Image processing testing: This involves testing the image processing component of the plant detection algorithm to ensure that it accurately extracts features from leaf images.Testers can use functional testing techniques such as boundary value analysis, equivalence partitioning, and decision table testing to test the image processing component

Plant detection testing: This involves testing the accuracy of the plant detection algorithm to ensure that it correctly classifies leaf images into different plant species.Testers can use functional testing techniques such as black box testing, white box testing, and regression testing to test the plant detection component

5.3.5 System Testing

System testing is typically done on the complete system, including all the components and interfaces, to ensure that it meets the specified requirements and operates as expected. It may involve both functional and non-functional testing.
1)Verify that the system starts up without errors and the camera is accessed properly.
2)Verify that the system detects a back camera's field of view and highlights it with a rectangle.
3)Verify that the system detects leaf and highlights them with rectangles.
4)Verify that the system classifies the leaf in the correct on the trained model.
5)Verify that the system that leaf is properly caputered or not .
6)Verify that the system gives you the proper name.

5.3.6 Test Result

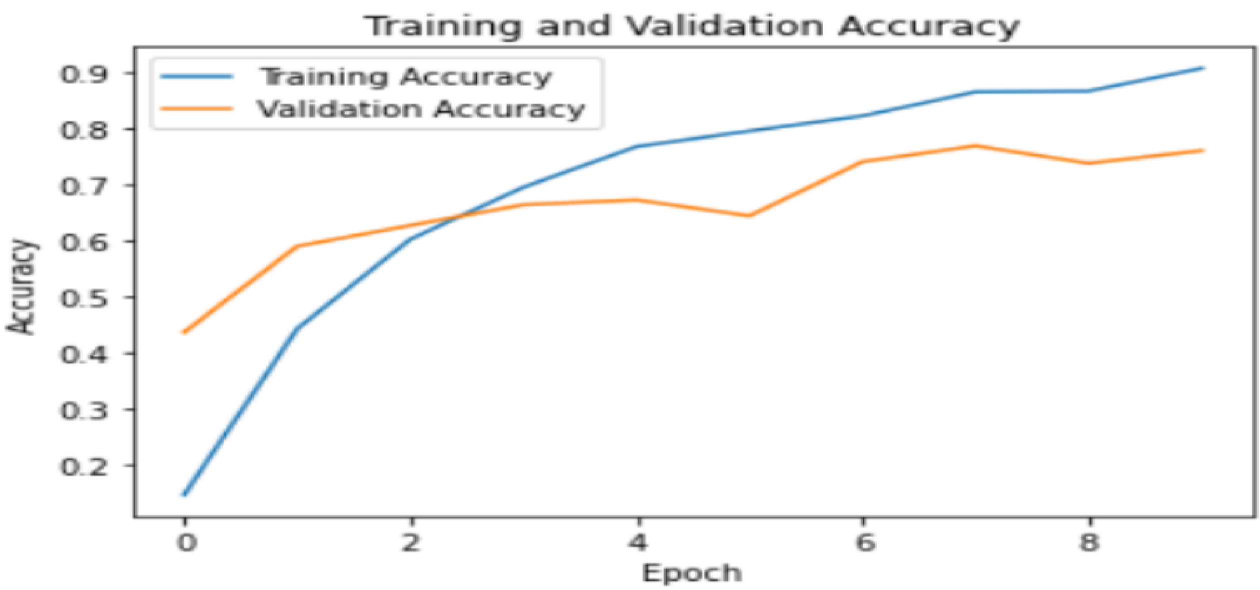

Figure 5.3: **Analysis of Accuracy Rate**

The Figure 5.4 describes the accuracy rate for the medicinal plant detection, Here the figure describes the functions to predict the class of a new leaf image uploaded by the user.

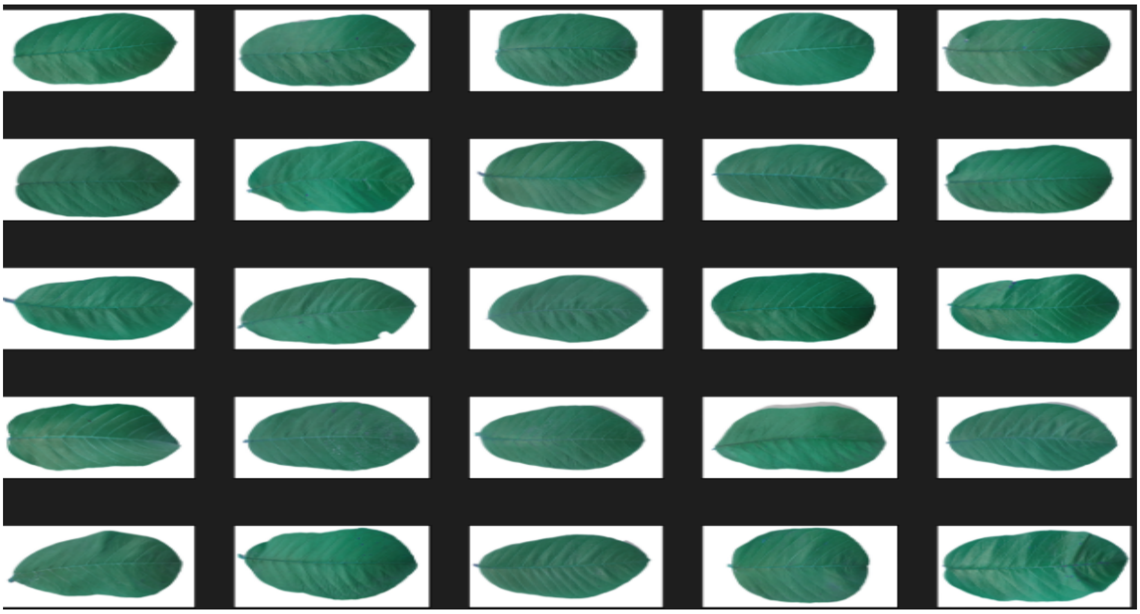

Figure 5.4: **Test Result of medicinal plants**

The Figure 5.5 describes the Test images of medicinal plants detection performed at various stages development process.

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

This plant detector is an image recognition technology designed to bring up relevant information related to plant, it identifies using visual analysis based on a neural network and let us know all the benefits of the plant. When directing the phone's camera at any plant, it will attempt to identify the object by search results, web pages, and information. A large number of features were extracted from each leaf such as its length, width, area, number of vertices, color, perimeter and area of hull.

6.2 Comparison of Existing and Proposed System

Agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. It also covers survey on different diseases classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithm.

6.3 Proposed system:

The proper identification of plant species has major benefits for a wide range of stakeholders ranging from forestry services, botanists, taxonomists, physicians, pharmaceutical laboratories, organisations fighting for endangered species, government and the public at large. Consequently, this has fueled an interest in developing automated systems for the recognition of different plant species. A fully automated method for the recognition of medicinal plants using computer vision and machine learning techniques has been presented.

6.4 Sample Code

```
import cv2

from matplotlib import pyplot as plt

import os

import numpy as np

from tensorflow.keras. preprocessing image import load.img
from tensorflow.keras.preprocessing. image import img-to-array
from tensorflow.keras.models import load model

filepath = "C:/Users/Madhuri/AppData/Local/Programs/Python/Python38/Tomato Leaf modet h5

model load_model(filepath)

print(model)

print("Model Loaded Successfully")
#Import necessary libraries
from flask import Flask, render_template, request
import numpy as np
import os

from tensorflow.keras.preprocessing.image import load_img

from tensorflow.keras.preprocessing.image import img_to_array

from tensorflow.keras.models import load_model

filepath = 'C:/Users/Madhuri/AppData/Local/Programs/Python/Python38/Tomato_Leaf_Disease_Prediction/
    model.h5'

model = load_model(filepath)
print(model)

print("Model Loaded Successfully")
def pred_tomato_dieas(tomato_plant):

  test_image = load_img(tomato_plant, target_size = (128, 128)) # load image
```

```
  print("@@ Got Image for prediction")

  test_image = img_to_array(test_image)/255 # convert image to np array and normalize

  test_image = np.expand_dims(test_image, axis = 0) # change dimention 3D to 4D

  result = model.predict(test_image) # predict diseased palnt or not
  print('@@ Raw result = ', result)
  pred = np.argmax(result, axis=1)
  print(pred)
  if pred==0:
      return "Tomato - Bacteria Spot Disease", 'Tomato-Bacteria Spot.html'

  elif pred==1:
      return "Tomato - Early Blight Disease", 'Tomato-Early_Blight.html'

  elif pred==2:
      return "Tomato - Healthy and Fresh", 'Tomato-Healthy.html'

  elif pred==3:
      return "Tomato - Late Blight Disease", 'Tomato - Late_blight.html'

  elif pred==4:
      return "Tomato - Leaf Mold Disease", 'Tomato - Leaf_Mold.html'

  elif pred==5:
      return "Tomato - Septoria Leaf Spot Disease", 'Tomato - Septoria_leaf_spot.html'

  elif pred==6:
      return "Tomato - Target Spot Disease", 'Tomato - Target_Spot.html'

  elif pred==7:
      return "Tomato - Tomoato Yellow Leaf Curl Virus Disease", 'Tomato -
          Tomato_Yellow_Leaf_Curl_Virus.html'
  elif pred==8:
      return "Tomato - Tomato Mosaic Virus Disease", 'Tomato - Tomato_mosaic_virus.html'
        # Randomize the order of training set
SEED = 42
train = train.sample(frac=1, random_state=SEED)
train.index = np.arange(len(train)) # Reset indices
train.head()
  elif pred==9:
      return "Tomato - Two Spotted Spider Mite Disease", 'Tomato - Two-spotted_spider_mite.html'



# Create flask instance
app = Flask(_name_)
# Display images for different species
def plot_plant(plant_types, rows, cols):
```

```
    fig, ax = plt.subplots(rows, cols, figsize=(12, 12))
    plant_files = train['File'][train['Plant Type'] == plant_types].values
    n = 0
    for i in range(rows):
        for j in range(cols):
            image_path = os.path.join(data_dir, plant_files[n])
            ax[i, j].set_xticks([])
            ax[i, j].set_yticks([])
            ax[i, j].imshow(cv2.imread(image_path))
            n += 1
# render index.html page
@app.route("/", methods=['GET', 'POST'])
def home():
        return render_template('index.html')


# get input image from client then predict class and render respective .html page for solution
@app.route("/predict", methods = ['GET','POST'])
def predict():
     if request.method == 'POST':
        file = request.files['image'] # fet input
        filename = file.filename
        print("@@ Input posted = ", filename)

        file_path = os.path.join('C:/Users/Madhuri/AppData/Local/Programs/Python/Python38/
            Tomato_Leaf_Disease_Prediction/static/upload/', filename)
        file.save(file_path)

        print("@@ Predicting class......")
        pred, output_page = pred_tomato_dieas(tomato_plant=file_path)

        return render_template(output_page, pred_output = pred, user_image = file_path)

# For local system & cloud
if __name__ == "__main__":
    app.run(threaded=False,port=8080)
```

Chapter 7

CONCLUSION AND FUTURE ENHANCEMENTS

7.1 Conclusion

The detection of medicinal plants using a web application can have significant benefits for promoting the use of traditional medicine and improving the safety and efficiency of herbal remedies. The project involves developing a machine learning model that can accurately classify medicinal plants from input images, preprocessing the images for better performance, and developing a web application that can provide relevant information about the identified plants. The proposed system will identify the system at 95 percent accuracy. Overall, a project for detecting medicinal plants can have far-reaching benefits for improving public health, preserving traditional knowledge, and promoting sustainable development.

7.2 Future Enhancements

The possible future enhancements for a project for detecting medicinal plants using a web application is adding more plant species as project grows, more medicinal plant species can be added to dataset, which can improve accuracy of machine learning model. Improving the user interface to make it more user-friendly and visually appealing. Additional features such as search functionality and interactive plant maps can also be added. Integrating with other systems such as databases, electronic health records, and mobile applications.Allowing users to identify medicinal plants on go and access relevant information anytime, anywhere. Overall, future enhancements for project for detecting medicinal plants can be limitless, and can be adapted to meet evolving needs of stakeholders and the industries.

Chapter 8

PLAGIARISM REPORT

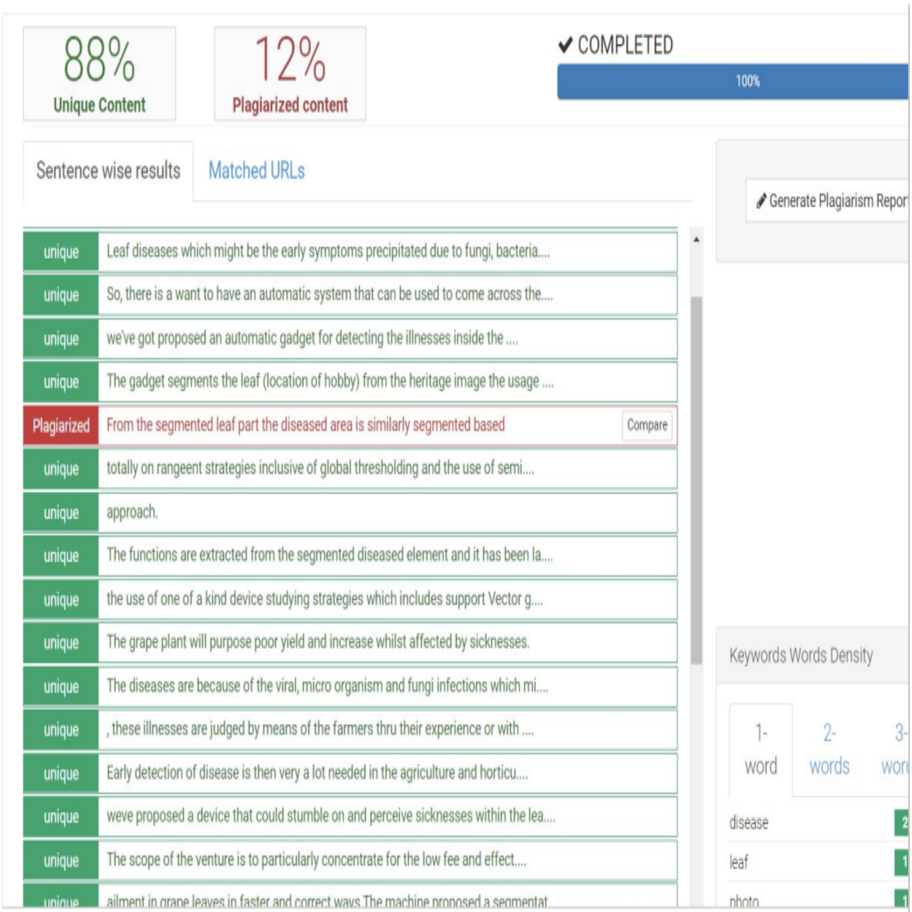

Figure 8.1: **Plagiarism Report**

Chapter 9

SOURCE CODE & POSTER PRESENTATION

9.1 Source Code

```
import os
from wsgiref.simple_server import WSGIServer
import tensorflow as tf
import numpy as np
from tensorflow.keras.utils import load_img, img_to_array


# Flask utils
from flask import Flask, redirect, url_for, request, render_template
from werkzeug.utils import secure_filename

# Define a flask app
app = Flask(_name_)



model =tf.keras.models.load_model('model.h5',compile=False)
print('Model loaded. Check http://127.0.0.1:5000/')


def model_predict(img_path, model):
    # Load the image and resize it to match the input size of the model
    img = load_img(img_path, target_size=(224, 224))
    # Convert the image to a numpy array
    img_array = img_to_array(img)
    # Normalize the image data
    img_array /= 255.
    # Expand the dimensions of the image array to match the input shape of the model
    img_array = np.expand_dims(img_array, axis=0)
    # Use the model to predict the class of the image
    prediction = model.predict(img_array)
    return prediction


@app.route('/', methods=['GET'])
```

```
def index():
    # Main page
    return render_template('index.html')


@app.route('/predict', methods=['GET', 'POST'])
def upload():
    if request.method == 'POST':
        # Get the file from post request
        f = request.files['file']

        # Save the file to ./uploads
        basepath = os.path.dirname(_file_)
        file_path = os.path.join(
            basepath, 'uploads', secure_filename(f.filename))
        f.save(file_path)

        # Make prediction
        preds = model_predict(file_path, model)
        print(preds[0])

        disease_class = ['Alpinia Galanga (Rasna)',
'Amaranthus Viridis (Arive-Dantu)',
'Artocarpus Heterophyllus (Jackfruit)',
'Azadirachta Indica (Neem)',
'Basella Alba (Basale)',
'Brassica Juncea (Indian Mustard)',
'Carissa Carandas (Karanda)',
'Citrus Limon (Lemon)',
'Ficus Auriculata (Roxburgh fig)',
'Ficus Religiosa (Peepal Tree)',
'Hibiscus Rosa-sinensis',
'Jasminum (Jasmine)',
'Mangifera Indica (Mango)',
'Mentha (Mint)',
'Moringa Oleifera (Drumstick)',
'Muntingia Calabura (Jamaica Cherry-Gasagase)',
'Murraya Koenigii (Curry)',
'Nerium Oleander (Oleander)',
'Nyctanthes Arbor-tristis (Parijata)',
'Ocimum Tenuiflorum (Tulsi)',
'Piper Betle (Betel)',
'Plectranthus Amboinicus (Mexican Mint)',
'Pongamia Pinnata (Indian Beech)',
'Psidium Guajava (Guava)',
'Punica Granatum (Pomegranate)',
'Santalum Album (Sandalwood)',
'Syzygium Cumini (Jamun)',
'Syzygium Jambos (Rose Apple)',
'Tabernaemontana Divaricata (Crape Jasmine)',
```

```
'Trigonella Foenum-graecum (Fenugreek)']
            a = preds[0]
            ind=np.argmax(a)
            print('Prediction:', disease_class[ind])
            result=disease_class[ind]
            return result
    return None


if __name__ == '__main__':
    app.run(port=5002, debug=True)

    # Serve the app with gevent
    http_server = WSGIServer(('', 5000), app)
    http_server.serve_forever()
    app.run()
```

9.2 Poster Presentation

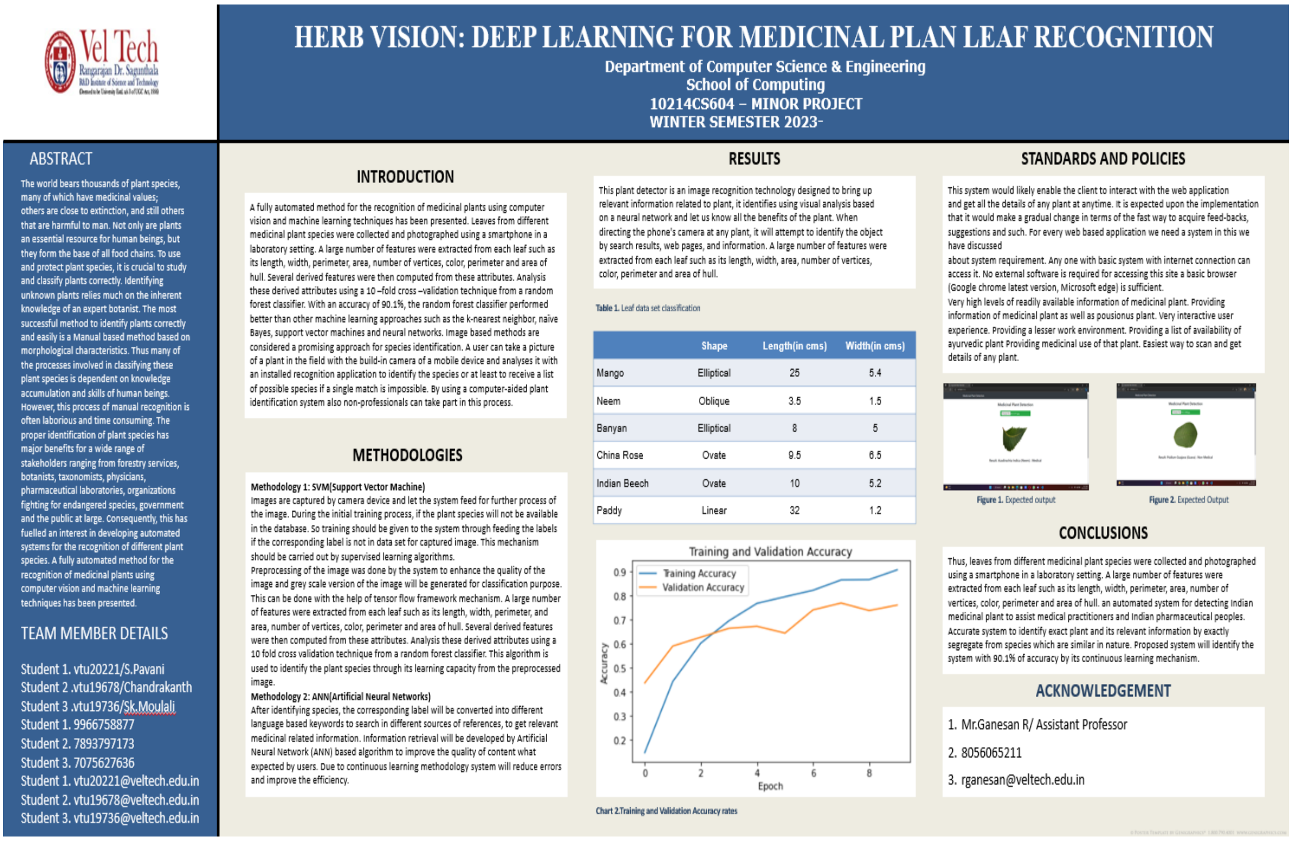

Figure 9.1: **Poster Presentation**

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