SMART ASSISTANCE FOR THE FLORICULTURE INDUSTRY

2023-133

Project Proposal Report

Gamage M.G.U.D.
IT19169736

B.Sc. (Hons) Degree in Information Technology Specialized in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology Sri Lanka

February 2023

SMART ASSISTANCE FOR THE FLORICULTURE INDUSTRY

2023-133

Project Proposal Report

Gamage M.G.U.D.
IT19169736

Dr. Sanvitha Kasthuriarachchi
Dr. Lakmini Abeywardhana

B.Sc. (Hons) Degree in Information Technology Specialized in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology Sri Lanka

February 2023

DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	**Student ID**	**Signature**
Gamage M.G.U.D.	IT19169736	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the Supervisor Date
(Dr. Sanvitha Kasthuriarachchi)

……. ..……

Abstract

Sri Lanka is a pioneer in floriculture production. Growers are setting up small and large-scale businesses across the island. Growers, on the other hand, face challenges due to a lack of smart solutions and inefficient technology. Currently, manual processes are used for key tasks such as plant growth monitoring, pest identification, maintaining export standards, predicting demand and supply, and selecting and caring for plants. Furthermore, newcomers to the industry face challenges with plant selection, environmental factors, resource-related factors, plant identification, and maintenance issues. A smart assistance system that can educate and assist growers in the industry is desperately needed. Various research studies have been conducted to develop suitable crop recommendation systems, flower identification systems, and chatbots using Internet of Things, machine learning, data analytics, deep neural networks, natural language processing, and artificial intelligence. However, there is no existing plant recommendation system for floriculture. The proposed system will utilize an open weather API to collect and process climate data based on the grower's location and consider infrastructure and resource-related factors when providing recommendations. The system will also include a variety identification system for popular Sri Lanka-based flowers and plants, as well as a chatbot application to help with caring and other important aspects of key floriculture plant species. Expertise of several subjects and technologies, such as machine learning, deep learning, image classification, natural language processing, and artificial intelligence, is required for the proposed project. The proposed system will be a powerful tool for the Sri Lankan floriculture industry, allowing growers to make smart decisions and improve business operations.

Keywords: floriculture, plant selection, beginners, weather data, resource, plant identification, chatbot, machine learning, natural language processing, deep learning, Sri Lanka, mobile application

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ANN	Artificial Neural Network
API	Application Programming Interface
BoW	Bag of Words
CNN	Convolutional Neural Network
CSV	Comma Separated Values
DCNN	Deep Convolutional Neural Network
DL	Deep Learning
IoT	Internet of Things
JSON	JavaScript Object Notation
ML	Machine Learning

NER	Named Entity Recognition
NLP	Natural Language Processing
NLTK	Natural Language Toolkit
NMT	Neural Machine Translation
RL	Reinforcement Learning
RNN	Recurrent Neural Network
VGG	Visual Geometry Group

LIST OF APPENDICES

1 INTRODUCTION

The floriculture sector is considered to be a high-income producing agribusiness with the potential to be exploited as a tool for Sri Lanka's social and economic development. [1] Growers all over the island are developing both small and large-scale businesses, but many are encountering a variety of issues due to a significant lack of smart solutions and inefficient technology. In the floriculture industry, key areas to consider include plant growth monitoring, pest identification, maintaining export standards, predicting demand and supply, and selecting plants and providing proper care. However, the majority of these tasks are currently performed manually using prior knowledge.

Beginners in the floriculture industry face a number of challenges. They are unsure of what plants to grow given their circumstances. Temperature, water, growing medium, humidity, wind, and precipitation are all environmental factors that influence plant growth. These variables will change depending on their current location. Financial stability, employee pool, and space available are all factors that influence the floriculture grower's performance. There is no appropriate mechanism in place to educate newcomers on such issues. Furthermore, they may misidentify plants, and it can be difficult to understand the fundamentals of plant growth and care, such as feeding, shade, and watering. There is no quick or efficient way to learn this information. So, there is a significant need of a smart assistance system to the floriculture industry in Sri Lanka.

Several research studies have been conducted in agriculture to select suitable plants. Research [2] and [3] use IoT to collect climate data and predict the most suitable crop using ML algorithms. Research [4] employs a data analytic algorithm to calculate a crop factor and advise farmers to grow the crop with the highest score. Research [5] uses RNNs to predict seasonal weather. Research [6] and [7] develop question-and-answer chatbots using NLP and ML to provide knowledge and solutions to farmers' agricultural questions. Research [8] develops a flower identification system using Google's Inception V3 deep

neural network. Research [9] has presented a variety identification and chatbot system for Anthurium growers.

According to the literature review, there is no existing plant recommendation system for floriculture, and that the crop recommendation systems that have been developed so far rely on weather factors collected by IoT to predict the most suitable crops for a particular area. The proposed system will use open weather API to collect and process climate data based on the grower's location and will consider infrastructure and resource-related factors as well when providing recommendations. The proposed system will utilize a dataset of popular flowers and plants among the Sri Lankan floriculture industry, such as orchids, anthuriums, and many others, as well as a chatbot application to provide growers with assistance related to the industry. The chatbot will provide various forms of assistance, such as caring for plants, watering, shading, fertilizers, soil preparation, lighting, harvesting, and other important aspects related to key floriculture plant species. Several subjects and technologies must be mastered in order to complete the proposed project. ML, DL, image classification, NLP, and AI are examples.

1.1 Background & Literature Survey

Sri Lanka is a global leader in floriculture production, providing a diverse selection of high-quality floriculture products. In 2021, Sri Lanka earned USD 16 million in income from floriculture exports. [10] Growers all around the island are establishing both small and large-scale businesses, but many experiences various problems due to the significant gap of smart solutions, and the inefficient technology currently in use. Monitoring plant growth, pest identification, maintaining export standards, predicting demand and supply and selecting plants identify varieties and giving proper care are key areas to consider in the floriculture industry. However, most of these tasks are currently done manually based on prior knowledge. The floriculture sector presents challenges for beginners with limited knowledge and experience, such as difficulty in selecting plants to grow, difficulty to

identify plant varieties, lack of education and resources, and difficulty in understanding plant care fundamentals. Selecting a suitable plant is crucial because many factors affect successful plant growth, and an individual should be able to choose a plant that is suitable for their environment and infrastructure.

Temperature is a major factor affecting floriculture crops, as demonstrated in a study by Kristin L. Getter in 2015 that explored the effects of average daily temperature on four floriculture crops, namely Geranium, Petunia, Marigold, and Pineapple mint. The study concluded that average daily temperature plays a significant role in flower and plant growth [11] . The keeping life of flower crops is also affected by air humidity, as proven in a study by Leiv M. Mortensen, [12] who experimented with four floriculture crops, including Begonia, Chrysanthemum, Poinsettia, and Blossfeldiana. The lowest humidity levels typically produced the highest plant quality, with fewer plants growing. Although the results varied by species and cultivar, the main finding was that humidity in the air has a sizable impact on maintaining life during growth. A study by Emmanuel de Langre [13] in 2008 explored the impact of wind on plants, showing its effects on plant growth. In 2022, research [14] was carried out to explore critical factors involved in plant development, which revealed that light, water, and nutrition are other main factors that influence plant growth. Understanding these factors is essential for manipulating plants to fulfill requirements and increasing production. Water availability and precipitation both have an impact on the physiology and ecology of a number of plants. The biological potential for water status of a plant is determined by rainfall. Although roots quickly grow in friable soil, their consumption of water and nutrients can be regulated through adequate interaction with the various soil phases.

When studying infrastructure variables influencing plant growth, land and space availability are critical. Because crops can be nurtured for several years in containers or in ground before being sold, advanced nurseries for plants often need a lot of room. In order to be lucrative, nurseries that grow adult trees in straight rows for transplant or for

sale need a minimum of one hectare of land [15]. According to the industry capability report of 2021, one of the industry's main advantages is the accessibility of a skilled labor force. The study of floriculture is taught in universities in order to produce skilled labor for the sector [10]. According to a 2017 study conducted by Padmini, S. M. P. C. And Kodagoda, T. D. [1] contrary to other sectors like agriculture, this one has serious financial challenges. Banks and other financial organizations might be reluctant to extend credit to this industry; therefore, the above environmental and infrastructure concerns should be considered by industry newcomers; otherwise, they may face several difficulties in the future. Furthermore, unexperienced industry beginners have a poor understanding of plant identification and plant care. Plants will be healthy and flourish if the proper conditions are met. There are no policies in place to inform them of this fact. As a result, beginners face numerous obstacles and difficulties, which discourage them. The main obstacles to developing policies in this field are a lack of resources and data.

To select a suitable plant, several researchers were conducted in the agriculture area. Research [2] , [3] uses IoT to gather the climate data like humidity, temperature, rainfall. And the most suitable crop is predicted using ML algorithms. Research [4] is based on a data analytic algorithm called Crop scoring. It is to calculate a crop factor based on Rainfall, soil type, cropping month and location. The farmer is advised to grow the crop with the highest score. According to the study [5] RNNs are being used to predict seasonal weather using soil factors, estimated weather characteristics, and random forest classification techniques. The flower identification system has been developed in research [8]. Using Google's Inception V3 deep neural network, flower varieties including roses, daisies, tulips, dandelion, and sunflowers are categorized. The assistance systems as chatbots have been developed according to the research [6], [7]. In [6] question-and-answer chatbot is being built to answer farmers' questions and provide knowledge using NLP. In research [7] NLP and ML are used to implement ANN to train a dataset of thousands of agricultural questions and their associated solutions. Research [9] presents a mobile application for Anthurium growers. NMT, RL, CNN and ML technologies are

used for detecting Anthurium varieties, managing plant care activities, diagnosing diseases and pests, helping planters, and predicting export quality with a chatbot.

1.2 Research Problem

The floriculture industry has emerged as a profitable business opportunity for many people who wish to explore the potential of growing and selling plants and flowers. In the Sri Lankan floriculture business, inefficient technology is currently in use. New technologies are being employed less frequently, and research and development are being concentrated less [10]. In the floriculture industry, significant topics to examine include plant growth monitoring, pest identification, maintaining export requirements, estimating demand and supply, and selecting plants, identifying varieties and providing right maintenance. However, the majority of these tasks are now performed manually using prior knowledge. Specially, the industry poses several challenges, particularly for beginners with limited knowledge and experience.

One of the significant challenges facing newcomers to the floriculture sector is selecting the right plants to grow. This is a crucial decision that can have a major impact on the advancement or failure of the business. Various environmental factors like temperature, humidity, wind and rainfall can influence the growth and development of plants. The geographical location of the floriculture grower can also impact the selection of the plants. For instance, plants that thrive in a hot and humid climate may not do well in an area with colder temperatures. Therefore, selecting the right plant for a particular location is a daunting task, particularly for beginners. However, beginners with limited knowledge may not know how to factor in these variables while selecting the best plant to grow. Figure 1-1 illustrates how beginner growers choose their plants, based on a survey that was conducted.

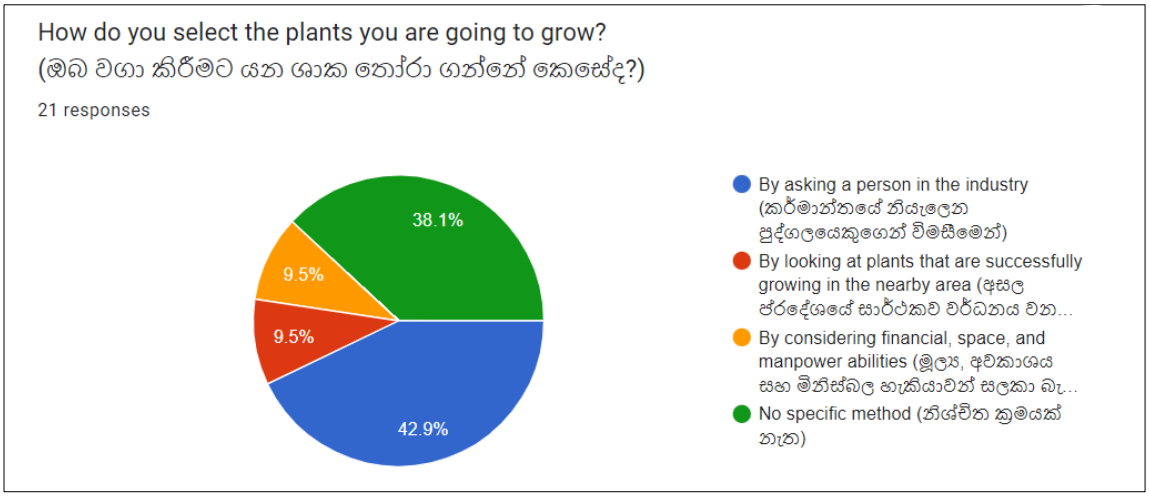

Figure 1-1 Survey to find how beginners select plants

Furthermore, the floriculture grower's financial stability, personnel pool, and available space are further factors that affect its performance. The success of a plant nursery is also influenced by the plant-growing medium and the accessibility of water sources. So resource-related factors should also be considered when selecting a plant. Some plants may need a lot of space, a lot of labor, and a large investment, while another plant may easily be grown with fewer resources. If the plants thrive, growers may encounter difficulties when extending their nurseries. They may not have enough space or funds to expand the business [1]. However, there is no adequate mechanism in place to determine which plants to grow based on those variables. If the plant does not thrive, the grower will be in difficulties, lose money and effort, and waste resources. The proposed system would consider various environmental factors such as temperature, humidity, wind speed, precipitation to predict the best plant to grow in a particular location using ML. And also, the proposed system will consider the finances, labor, space, growth medium, water supply availability as well. The survey found that an automated solution would be useful for this. (Figure 1-2)

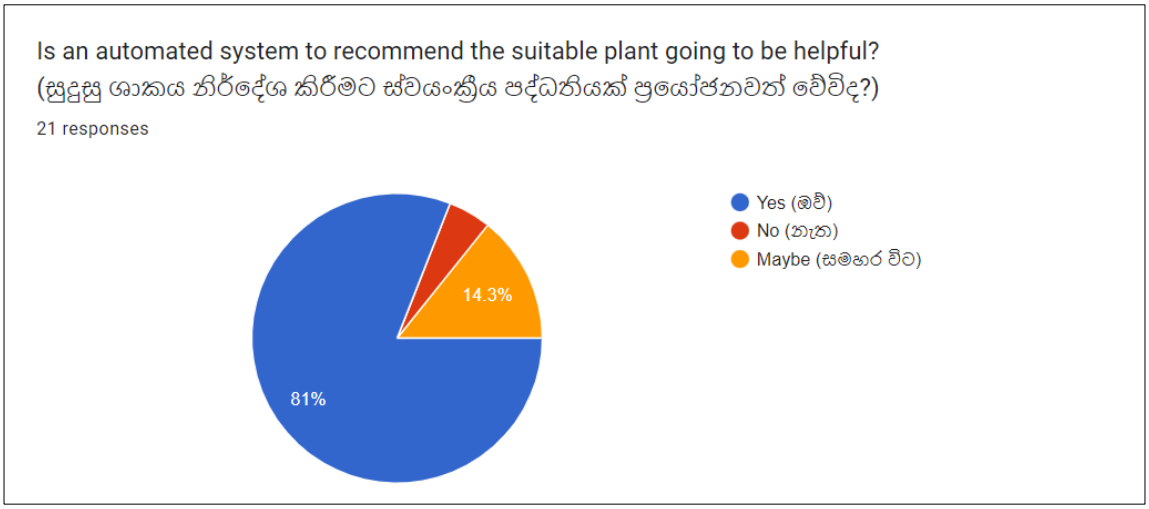

Figure 1-2 Survey to identify if an automated system is useful

Another issue in the floriculture sector is the identification of plant species. With so many different types of plants available in Sri Lanka, it can be difficult to tell one from the other. Carnations, Roses, Chrysanthemums, Lilies, and Gerberas, Anthuriums, Orchids, Heliconias, and Ginger are among the flowers and plants mostly grown in the floriculture sector [16]. If consider Orchids, there are varieties including Phalaenopsis, Nobile, Dendrobium, Vanda, Cattleya, and Oncidium. As a result, distinguishing between varieties may be difficult for a newcomer. Furthermore, there are no proper and easily accessible sources to identify Sri Lanka-based plants and flowers. So the beginners feel difficulties in this scenario.

Another challenge that beginners in the floriculture industry face is a lack of knowledge about the fundamentals of growing and taking care of plants. Although there are many ways for newcomers to learn, Figure 1-3 shows that the majority of them lack a proper and dependable approach.

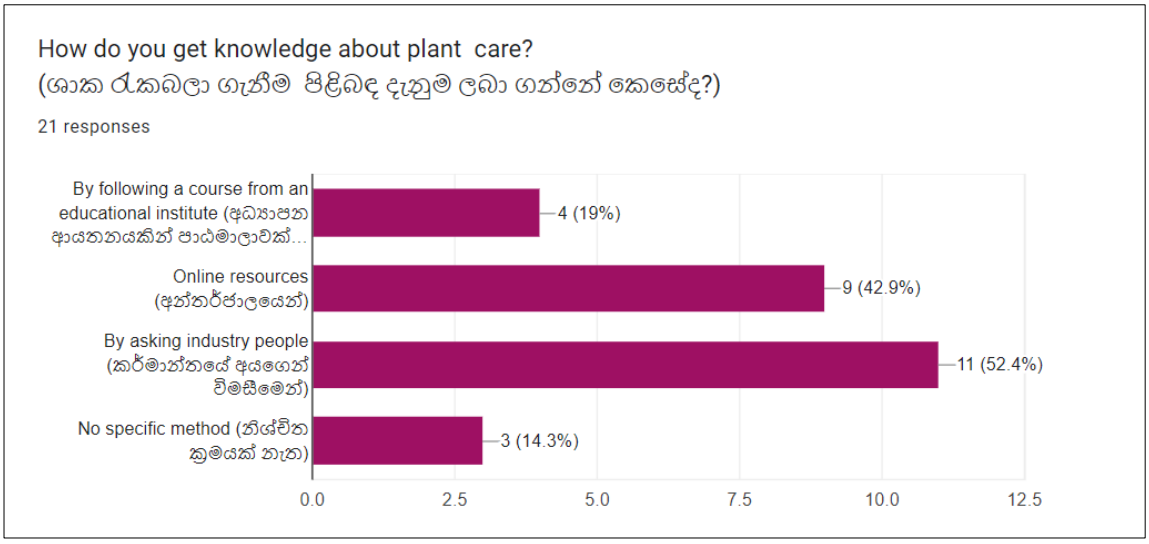

Figure 1-3 Survey on the knowledge sources of beginners

For example, knowing how much to water a plant or the amount of shade it requires can be difficult for someone who has never grown plants before. Additionally, providing the right nutrients to the plant is essential to ensuring its healthy growth, but beginners may not know what fertilizers to use or in what quantities. The proposed system would provide assistance in identifying different plant varieties using DL. And the proposed system would provide accurate and reliable information about the different plant species and their requirements for growth and maintenance as an NLP chatbot. According to Figure 1-4, the survey revealed that a chatbot is beneficial.

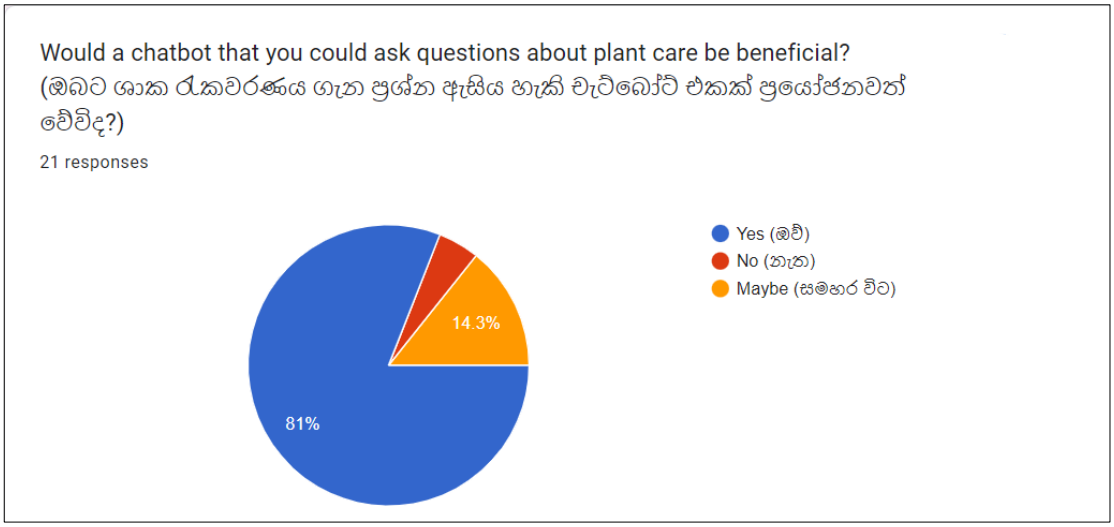

Figure 1-4 Survey on the usefulness of a chatbot

By doing so, the proposed system would be beneficial to beginners in the floriculture industry, making it easier.

1.3 Research Gap

The following is a description of related research done locally as well as internationally.

Research [2] is about an IoT and ML-based Agriculture system that will assist farmers and agriculturists predict crop yields. The goal of this study was to predict an efficient crop that may be cultivated in a specific field area and result in a high crop yield. Predictions are made using metrological data such as temperature, humidity, soil moisture, and so on. Metrological data is gathered via an IoT-based sensor system. The crop is predicted using the ML algorithm.

In [3], the user, would be able to use this system to get correct advice on which plant will thrive depending on various factors such as humidity, pH, and rainfall. IoT is used to measure these factors. To train the dataset and make the forecast, ML algorithms were utilized.

In [4], Crop scoring is a data analytic algorithm that has been used in research. Rainfall and soil type were acquired based on region, and farmers provided cropping month and location. The crop factor is then calculated using a mathematical model that assigns values to variables and adds them. The farmer is advised to grow the crop with the highest score.

[5] RNN is being used for seasonal weather predicting. Crop selection models incorporate soil factors such as soil type, pH, fertility, and water holding capacity. The soil and estimated weather characteristics are combined to select appropriate crops for land. The random forest classification technique is used to classify appropriate crops.

[6] is a floriculture industry smartphone application. DCNN is used to detect disease in roses and sunflowers. In addition, a question-and-answer chatbot is being built utilizing NLP, together with a knowledgebase system, to answer farmers' questions and provide knowledge regarding disease treatments. RL is also being used to build automated floriculture recommendations that comply with demand predictions.

[7] NLP and ML are used to implement ANNs. The algorithm was trained on a dataset containing a number of agricultural questions and associated solutions. The Chatbot's interface will be presented as a website or a Mobile Application. Questions about agriculture, such as the amount of rainfall needed for crops, the state of the soil, and the seedlings, the weather, fertilizers, and so on may be simply addressed by the chatbot and provided in text form.

[8] Describes a DL-based strategy for flower identification and classification. The study's image samples include images of a variety of flowers, including tulips, roses, daisies, sunflowers and dandelions. In pursuit of greater accuracy in less time, Google's Inception V3 deep convolutional neural network's final layers have been re - trained for classifying on the ornamental plants data set.

[9] Introduces a mobile application for detecting 5 different types of Anthurium plants, managing plant care activities, diagnosing 3 diseases, offering safety measures, forecasting 5 pests, helping planters, and providing a way for planters to locate a market, assess export quality, and predict the most popular kind. NMT, RL, CNN, image processing, and ML technologies are used.

Based on the studies conducted, it has been observed that there are various crop recommendation systems available for agriculture on an international level. However, when it comes to floriculture, there is no existing plant recommendation system to assist growers in selecting the best plants for their specific needs. The crop recommendation systems that have been developed so far utilize weather factors to predict the most suitable crops for a particular area. However, these systems usually rely on IoT devices to measure weather factors accurately. The proposed system, on the other hand, will make use of open weather API to collect and process climate data based on the grower's location. Furthermore, the previously developed crop recommendation systems have not focused on the grower's infrastructure and resource-related factors, such as labor availability and land size, cost, growing media, water availability when predicting the ideal plant. However, the proposed system will consider these factors when providing recommendations.

Although there have been studies conducted on flower identification using DL techniques, the flower categories used in these studies are quite limited. Therefore, the proposed system will utilize a dataset of popular flowers and plants among the Sri Lankan floriculture industry, such as Orchids, Anthuriums, and Philodendron which are having numerous varieties. Additionally, the proposed system will have a chatbot application that will provide growers with assistance related to the floriculture industry. Chatbots have been developed to utilize a knowledgebase of information on diseases and their treatments or for one particular plant previously, but the proposed system will provide growers with various forms of assistance, including caring for plants, watering, shading, fertilizers, soil

preparation, lighting, harvesting, and other important aspects related to multiple key floriculture plant species. Table 1-1 compares the proposed system with past studies.

Table 1-1 Past research

Reference / **Features**	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	Proposed system
Obtain the climate data without hardware devices	-	-	-	-	-	-	-	-	✓
Predict the best floriculture plant to grow considering weather and infrastructure factors	-	-	-	-	-	-	-	-	✓
Identify varieties of multiple floriculture crops	-	-	-	-	-	-	-	-	✓
Chatbot to assist in plant care for multiple floriculture crops	-	-	-	-	✓	-	-	-	✓
Mobile application	-	✓	-	-	✓	✓	-	✓	✓

2 OBJECTIVES

2.1 Main Objective

Plant recommendation, variety identification and chatbot for industry beginners

2.2 Specific Objectives

- Obtain the climate data without hardware devices based on the grower's location
- Predict the best floriculture plant to grow considering weather and infrastructure factors
- Identify varieties of multiple floriculture crops
- Chatbot to assist in plant care for multiple floriculture crops
- Mobile application development

3 METHODOLOGY

3.1 Overall System Architecture

The following Figure 3-1 explains the overall architecture of the complete system.

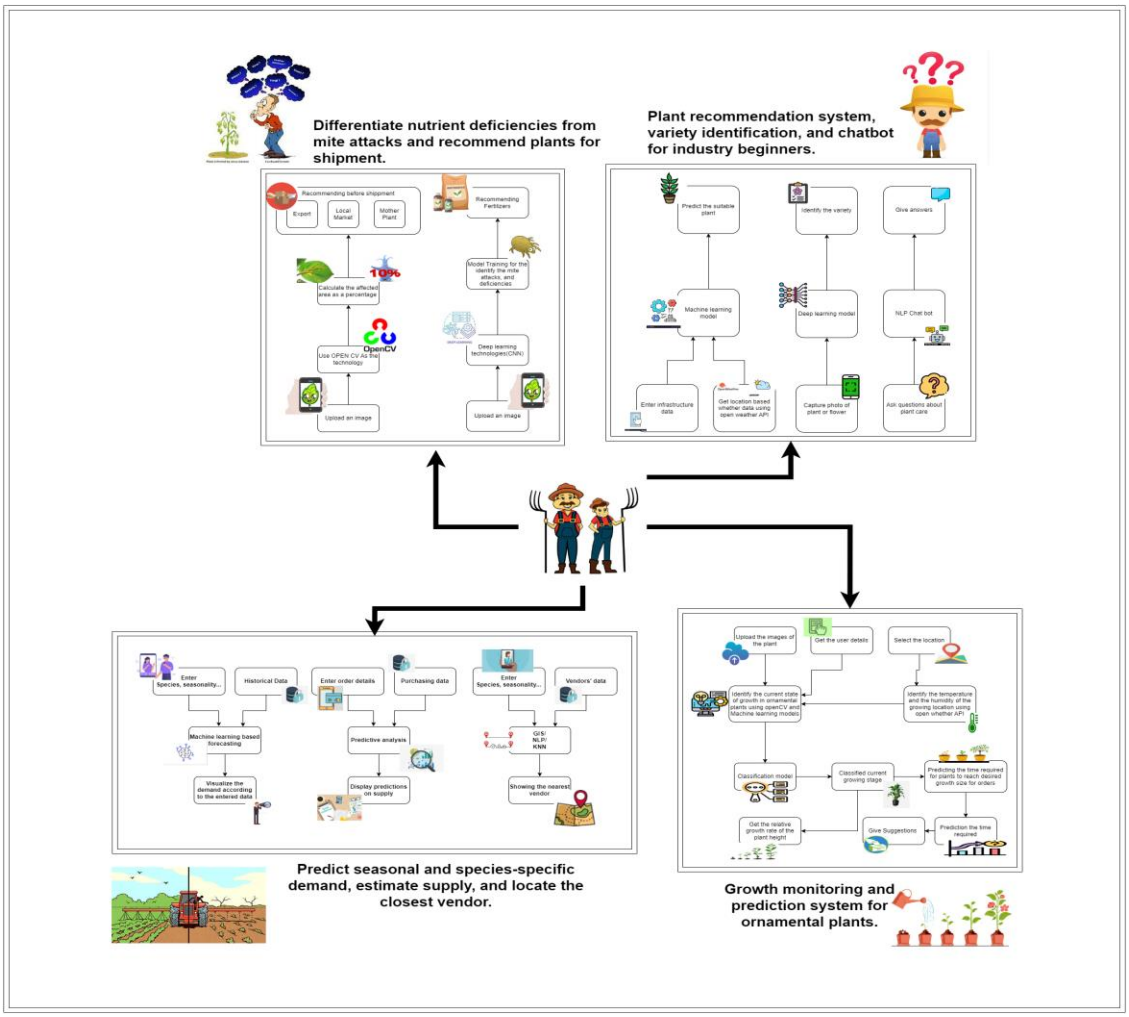

Figure 3-1 Overall system diagram

The suggested system would be developed in accordance with the Agile software development process shown in Figure 3-2.

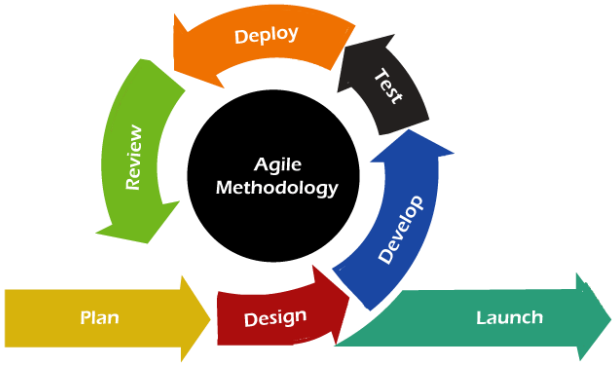

Figure 3-2 Agile methodology

3.2 Individual System Architecture

Figure 3-3 explains the individual component of the system architecture. Including Plant recommendation system, variety identification system and chatbot application.

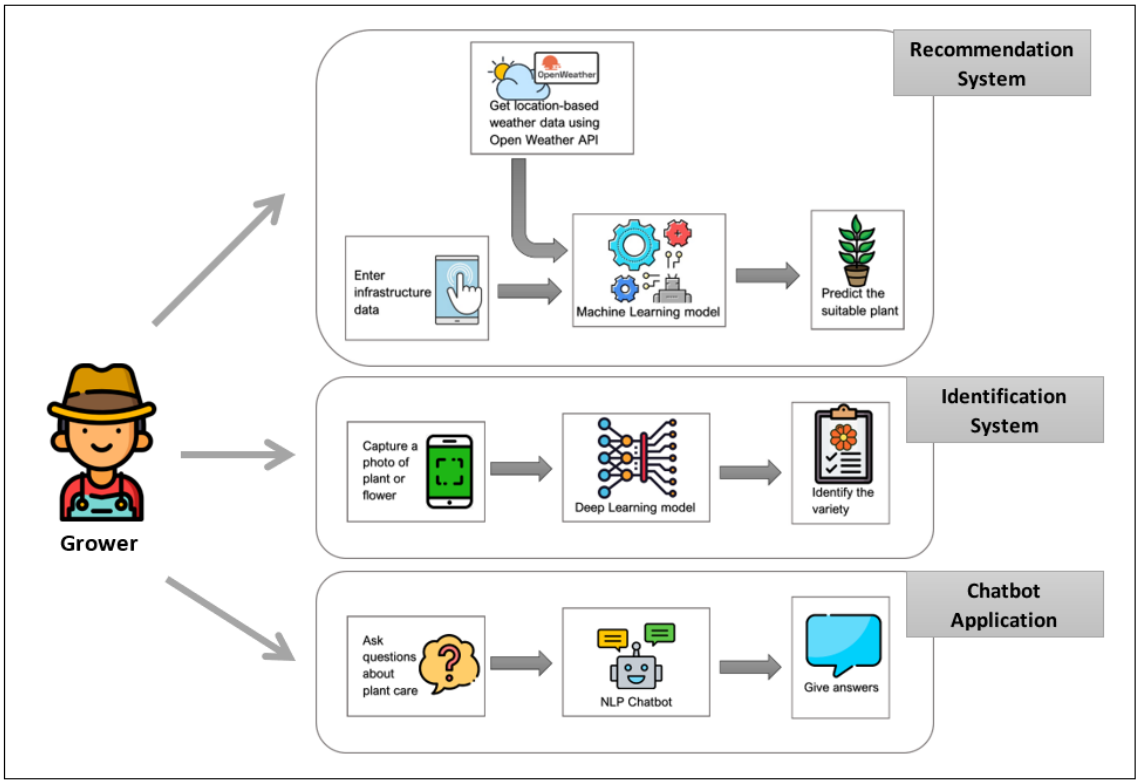

Figure 3-3 Individual system diagram

Table 3-1 summarizes the technologies, algorithms, architectures and techniques which will be used in the implementation of the proposed system.

Table 3-1 Summary of tools and technologies used

Technologies	Algorithms & architectures	Techniques
React Native Python Tensorflow Keras scikit-learn NLTK SpaCy Open Weather API	Supervised learning ANN CNN NER	Data preprocessing Feature engineering Transfer learning Data augmentation Intent Recognition Entity Recognition Dialog Management

3.2.1 Obtaining weather data

- The location of the grower will be obtained.
- To access weather data, the open weather API will be used.
- The average weather data forecast will include data such as temperature, humidity, precipitation, and wind speed.

3.2.2 Plant recommendation system

- Collecting data

Through floriculture growers and the Sri Lanka Meteorological Department, the information needed for the plant recommendation system is gathered. For data gathering, the best flower nurseries in Sri Lanka will be chosen. The plant's species name and information pertaining to the resource will then be gathered. The records of the nurseries will be gathered from the beginning date to the present date of growth for resource-related data. The data are space required for the nursery, growing media, number of plants, water supply amount, number of laborers worked, cost of the nursery's maintenance, etc., and then the average past weather

data for the particular period will be collected from the Data Processing and Archival Division of the Meteorological Department, Sri Lanka. The weather data are temperature, relative humidity, precipitation, and wind speed.

- Preparing data

The gathered data will be combined as features and labels in CSV format. The weather and resource-related data will be features. The best-growing plant species in that specific nursery is identified on the label. The data will then be cleaned by dealing with duplicate, missing, and wrong values. Data visualization will also be carried out. Next, testing and training sets will be devised from the dataset.

- Feature engineering

The efficiency of the model will be enhanced through the creation, transformation, extraction, and selection of features.

- Training the model

With a prepared dataset, the best ML model will be headed and compared to other models like Decision Tree and Random Forest.

- Evaluating the model

In order to determine the model's performance measures, such as accuracy, precision, recall, F1 score, confusion matrix, test data will be used.

- Hyperparameter tuning

To discover a set of optimal hyperparameter values, random search and grid search tuning will be carried out.

- Prediction

The resource-related information will be entered into the system by grower. Then, with the location-based weather data, ML model can determine the appropriate plant.

3.2.3 Variety identification system

- Collecting data

Omega Green Pvt. Ltd. Will be contacted for the images of 5 Anthurium varieties, 5 Orchid varieties, and 5 Philodendron varieties. The images will then be gathered and organized into separate folders with class names.

- Preprocessing data

Augmentation will be used to effectively increase the quantity of data. The model gains knowledge of all these variants through data augmentation techniques like flipping, rotating, cropping, and scaling. This greatly improves the model's accuracy. Additionally, images are resized in accordance with the CNN model's input size. Next, testing and training sets will be created from the dataset.

- Training the model

To classify all plant and flower varieties, a CNN model will be developed and trained. In order to classify images, a pre-trained network, such as VGG-16 or MobileNet-v2, will be used to extract features as well as train another layer on top called transfer learning. And the best model will be chosen based on how well it performs.

- Evaluating the model

Then test data will be used to evaluate the performance metrics for the custom and pretrained models, including accuracy, precision, recall, the F1 score, and the confusion matrix.

- Hyperparameter tuning

To discover a set of ideal hyperparameter values, random search and grid search tuning will be carried out.

- Prediction

The user's captured image of the plant or flower will be processed before being fed into the CNN algorithm. The predicted result will then be displayed.

3.2.4 Chatbot application

- Collecting data

A significant set of questions and answers about plant care is required. This information will be gathered through documents, online forums, and plant care specialists. There will be a JSON file created for intents. The questions will be categorized using a set of tags and patterns.

- Preparing data

The BoW encoding scheme will be used to convert the data to numbers. And kept in two arrays for features and target variables.

- Training the model

Using the dataset, the neural network will next be built and trained. The model will choose a suitable response from the tag connected to the specified feature.

- Testing

To find any problems or defects, the chatbot has to be evaluated with actual users. The chatbot can be enhanced and developed based on the input.

- Prediction

The query can be entered by the user and cleaned. The BoW model is then used to translate text into numerical values and predict what tag in the intent the features closest correspond to. Pre-written responses will be provided by the chatbot in place of inquiries.

3.3 Commercialization & Business Plan

The commodity version will be developed as follows:

- Forecast of ornamental plant growth at the present time
- Determining the relative rate of plant height growth
- Differentiating between mite attacks and nutritional shortages
- Determining the best plant for floriculture based on resource and weather considerations
- Predicting the demand for both domestic and foreign markets

The premium version will be developed as follows:

- Estimating how long it will take a plant to develop to the size needed for an order
- Making recommendations to encourage growth and progress the ornamental plant to its next stage
- Recognizing different varieties of floriculture crops
- Using a chatbot to provide advice on how to grow plants
- Plant recommendations for shipments
- Determining the closest vendor and predicting the best supply strategy based on geography to meet the specified output quantity
- Giving packaging advice depending on the plant’s life expectancy

4 PROJECT REQUIREMENTS

4.1 Functional Requirements

- System should be able to obtain the climate data forecast based on the location
- System should be able to get infrastructure data from the user
- System should be able to predict the best plant to grow
- System should be able to capture a photo of a plant or flower using the mobile phone camera
- System should be able to identify the plant or flower variety
- System should be able to get user questions and provide answers using a chatbot

4.2 Non-Functional Requirements

- Reliable: The system should be dependable and trustworthy, and it should consistently produce accurate and consistent results.
- Fast: The system should be designed to perform tasks quickly and efficiently, with minimal delays or wait times.
- Accurate: The system should be designed to provide accurate and precise results, with a high level of data integrity
- User-friendly: The system should be easy to use and navigate, with a simple and intuitive user interface with clear instructions

4.3 System Requirements

- Python will be used to implement the backend
- Tensorflow will be used for ML and DL model development and training
- Spacy will be used for building and deploying NLP pipelines

- VS Code will be used as the code editor that is used for writing and debugging code
- Jupyter Notebook will be used for data analysis, data visualization, and ML
- React Native will be used for building mobile application for iOS and Android platforms.
- Flask Server will be used for deploying ML model

4.4 User Requirements

- The user should be able to allow the app to access their location to obtain weather data for their area.
- The user should be able to enter details about the infrastructure they have available, such as cost, space, manpower, growth medium, and water supply.
- The user should be able to capture a picture of a plant or flower with their smartphone camera and have the app identify the plant's variety name.
- The user should be able to ask questions about plant care from a chatbot within the app.

5 GANTT CHART

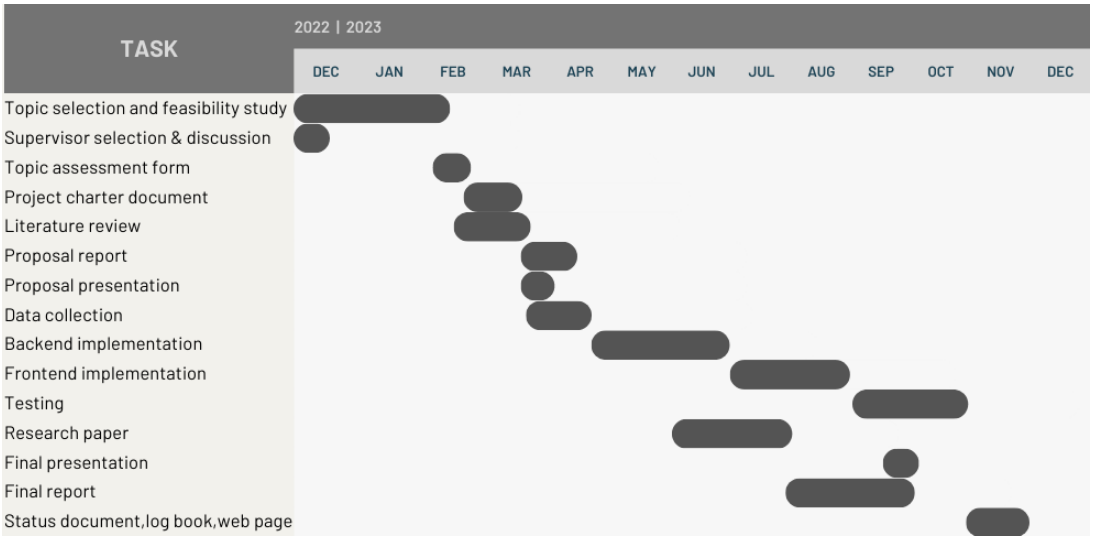

Figure 5-1 Gantt chart

6 WORK BREAKDOWN STRUCTURE

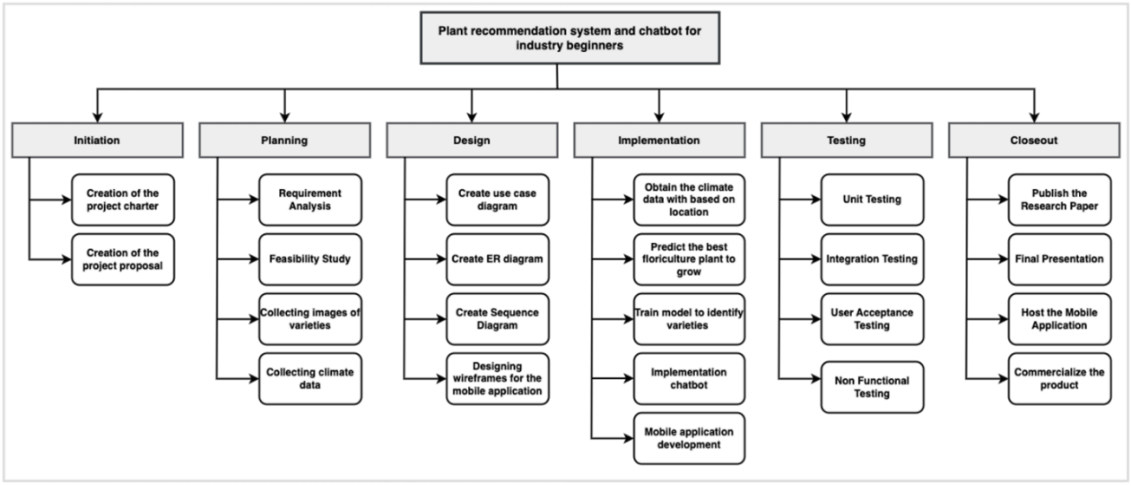

Figure 6-1 Individual work breakdown structure

7 BUDGET AND BUGET JUSTIFICATION

The overall budget for the proposed system is shown in Table 7-1 below.

Table 7-1 Budget estimation

Component	Price
Travelling cost and other expenses	Rs. 30000
Deployment Cost	Rs. 8000/Monthly
Cost for past weather data from Department of Meteorology	Rs. 5000
Cost for OpenWeatherMap API	Rs. 1960/location
Cost for hosting the mobile app on play store	Rs. 8075
Cost for hosting the mobile app on App store	Rs. 22610/monthly

REFERENCES

[1] S. M. P. C. a. K. T. D. Padmini, "Present status and future scope of floriculture industry in Sri Lanka and its potential in women empowerment," *Sri Lanka Journal of Social Sciences,* pp. 31-40, 2017.

[2] S. B. A. G. D. P. A. Y. Prof. Swati Dhabarde, "Agricultural Crop Recommendation System Using IoT and M.L.," *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT),* vol. 2, no. 1, 2022.

[3] M. B. J. S. S. P. S. D. K. Sameer. M. Patel, "Smart Agriculture using IoT and Machine Learning," *International Research Journal of Engineering and Technology (IRJET),* vol. 8, no. 4, 2021.

[4] M. K. Sharma, S. Agrahari, S. Tyagi and S. Punia, "Crop Selection Using Data Analytics," in *2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN)*, Greater Noida, India, 2020.

[5] S. Jain and D. Ramesh, "Machine Learning convergence for weather based crop selection," in *2020 IEEE International Students' Conference on Electrical,Electronics and Computer Science (SCEECS)*, Bhopal, India, 2020.

[6] U. S. S. a. A. D. H. L. a. K. M. C. a. L. A. B. a. W. F. W. M. K. S. S. Samaratunge Arachchillage, "Smart Intelligent Floriculture Assistant Agent (SIFAA)," in *2021 3rd International Conference on Advancements in Computing (ICAC)*, Colombo, Sri Lanka, 2021.

[7] N. a. D. C. a. K. T. a. S. M. a. N. T. Chandolikar, "Agriculture Assistant Chatbot Using Artificial Neural Network," in *2022 International Conference on Advanced Computing Technologies and Applications (ICACTA)*, Coimbatore, India, 2022.

[8] S. a. B. G. a. S. R. N. V. a. A. P. K. Dharwadkar, "Floriculture classification using simple neural network and deep learning," in *2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT)*, Bangalore, India, 2017.

[9] R. Rathnayake, M. T. Pramodi, I. Gayathree, L. Rashmika, M. Gamage and A. Gamage, "BlossomSnap: A Single Platform for all Anthurium Planters Based on The Sri Lankan Market," in *2022 IEEE 13th Annual Information Technology,*

Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, Canada, 2022.

[10] E. A. D. E. S. L. Mr. Gayan Weerasinghe - Export Promotion Officer, "INDUSTRY CAPABILITY REPORT - Sri Lankan Floriculture Sector," Export Development Board (EDB), Sri Lanka, 2021.

[11] K. L. Getter, "Average Daily Temperature Effects on Paclobutrazol Efficacy of Four Floriculture Crops," *HortTechnology*, vol. 25, no. 6, p. 742–746, 2015.

[12] L. M. Mortensen, "Effects of air humidity on growth, flowering, keeping quality and water relations of four short-day greenhouse species," *Scientia Horticulturae*, vol. 86, no. 4, pp. 299-310, 2000.

[13] E. d. Langre, "Effects of Wind on Plants," *Annual Review of Fluid Mechanics*, vol. 40, pp. 41-168, 2008.

[14] A. J. H. T. S. M. A. G. Z. K. B. C. U. Hemant Upadhyay, "Exploration of Crucial Factors Involved in Plants Development Using the Fuzzy AHP Method," *Mathematical Problems in Engineering*, p. 9, 2022.

[15] "SPACE NEEDED FOR A PLANT NURSERY," ACS Distance Education, 10 June 2019. [Online]. Available: https://www.studyacs.com/blog-space-needed-for-a-plant-nursery-1061.aspx.

[16] "Sri Lanka Export Development Board," [Online]. Available: https://www.srilankabusiness.com/floriculture/cut-flowers.html.

APPENDICES

Appendix 1 : Survey on Floriculture Industry

https://forms.gle/mknPpztYp63e2wJE8