GROWTH PREDICTION, DISEASES DETECTION & CLASSIFICATION SYTEM FOR ANTHURIUM PLANTS

Project Id: 17-082

Project Proposal Report

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In Information Technology

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DECLARATION

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

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

Signature of the supervisor :……. Date :……

Abstract

Anthurium is very popular as an exotic – cut flower plant and also it holds an important place as an economic flower in export market due to its attractiveness. So Anthuriums are planted in a large scale for business purposes as it is financially very profitable self-employment. Most of the time Anthurium planters report about common bacterial and fungal diseases that affects to the harvest of the plantation. Traditional naked eye observation is sometimes insufficient, inaccurate to identify the diseases in its early stage. Proposed system is capable of analyzing an image of the plantation which is randomly taken at a time during a day using segmentation techniques in image processing, and identify whether any disease is being spread through the plantation at the early stage of the disease. And also, Artificial neural network(ANN) is being trained with the data of diseased anthurium plant information and Artificial neural network is used to classify and detect the disease mentioning cause, disease and prevention methods to the user in a voice output. By considering factors like humidity, temperature and sun light inside the green-house environment, neural network predicts the growth abnormalities that can be happen to the plantation. Proposed system will be a helping hand for anthurium planters as it helps to detect diseases at earlier stages and also helps to maintain the healthy growth of the plantation through the predictions done by the neural network.

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1. INTRODUCTION

1.1. Background And Literature Survey

1.1.1. Background

This proposed system is a growth prediction and disease detection system for Anthurium plant. Proposed system has the capability of analyzing an image using image segmentation techniques and, trained artificial neural network is used to classification and detection of the disease. And also system is capable of gathering information regarding humidity, temperature and sun light and neural network will predict the growth of the plants using past information considering those (humidity, temperature and sun light) factors. And system will warn the user by voice output and also giving the cause, disease and the instruction for prevention.

This proposed system is worthy of implementing due to so many reasons. Those reasons are Anthurium is very popular exotic – cut flower plant and also it is used for many occasions because of its attractiveness. Because of that Anthurium is very financially profitable plant not only in Sri Lanka, but also in export market as well. So most of the cultivators tend to cultivate Anthurium as a self-employment. In that because of the impossibility of identify the diseases affects to Anthurium plant at their earliest stages many cultivators lost their harvest. And it creates big financial losses to cultivators. So this proposed system is a great solution for that as it has the capability of identifying the diseases at earlier stages and also it can predict the abnormalities of the growth of the plant so that farmers can prevent the diseases before it spread across the whole plantation and so that this system is a great benefit for larger scale Anthurium planters.

1.1.2. Literature survey

Throughout the literature survey in the field of Agriculture and Information technology, there are several applications have been used for detection of diseases using image processing techniques and different classification systems for diseases diagnosis for various plants using neural network techniques and there are various researches have been done in plant growth monitoring systems also.

Many research papers have already been published for detection of diseases in leaves of plants which focus primarily on various segmentation techniques like Threshold method, Method of K-means clustering, histogram based method. [6]

No	Title	Publication	Year	Author
1	Potato Leaf Diseases Detection and Classification System	IJSMC	2016	Mr.Girish Athanikar, Ms.Priti Badar.
2	Leaf Disease Detection using Image Processing Technique	IJIREEICE	2016	Piyali Chatterjee, B. Harikishor Rao.
3	Plant Disease Detection Using Image Processing Techniques	IJIRSET	2015	Y.Sanjana,AshwathSivasam, SriJayanth.
4	Image Processing Techniques for Detection of Leaf Disease	IJARCSSE	2013	Arti N.Rathod, Bhavesh Tanawal, Vatsal Shah.
5	Automatic Detection and Classification of Plant Disease	IJARCSSE	2013	Mr. Pramod S. landge, Sushil A. Patil, Dhanashree S. Khot,

	through Image Processing			Omkar D. Otari, Utkarsha G. Malavkar.
6	Fast and Accurate Detection and Classification of Plant Diseases	IJCA	2011	H.Al-Hiary, S.Bani-Ahmad M. Reyalat, M. Braik and Z. ALRahamneh.

Table 1. Published research paper review for detection of diseases in leaf plants.

In pattern recognition and image processing, feature extraction is a special form of dimensionality reduction. [8] Features can be classified as application independent features such as color, texture, and shape. [16] For an image, a feature can be defined as the "interest" part of the image. These features play a fundamental role in classification. [8]

There are several applications for classification of diseases using extracted features in the literature.

A. Menukaewjinda et al. [7] developed a system to identify diseases in grape leaves using color imaginary implementing a hybrid intelligent system. The system includes grape leaf disease segmentation, grape leaf color segmentation and classification of diseases. This has used a self-organizing feature map with a BPNN to recognize leaf colors. This has used SVM classification. This has also used Gabor Wavelet to analyze color features more efficiently. Then SVM is again used to classify grape leaf diseases. Girish Athanikar et al. [8] has developed a neural network based classification system for detecting diseases of potato leaves. Image segmentation is done through K-means clustering algorithm. Area, texture and color features are extracted for better implementation. The neural network is trained using BPNN algorithm. This is proved to have an accuracy of 92%.

N.Satya Priya et al. [9] has proposed a system for lemon leaf disease detection using knowledge based approach. This consists of feature extraction from the image of a leaf and identifying the type and disease stage. RGB images are converted to gray scale format. Disease portion is extracted using edge detection technique.

Artificial neural networks have used for different predictions in various systems as well as for harvest predictions. There are different approaches for various plants growth prediction by considering various other factors such as water in the soil. Although relative water contents a widely-used measure of water status that does not require sophisticated equipment, it is often argued that water potential, especially of the leaves is a more rigorous and more generally applicable measure of plant water status [1]. Number of instruments are available for monitoring of leaf thickness. Approaches include direct measurement using linear displacement transducers [2]. Stem is another place where growth can be measured. Nevertheless, the diurnal dynamics of changes in diameter, especially of fruits, have been used to derive rather more sensitive indicators of irrigation need, where the magnitude of daily shrinkage has been used to indicate water status, and comparisons of diameters at the same time on succeeding days give a measure of growth rate. [3]

The use of expert systems, which integrate data from several sources, appears to have great potential for combining inputs from thermal or other crop response sensors and environmental data for a water budget calculation to derive a robust irrigation schedule. [4] Kacira and colleagues have developed and tested on a small scale an automated irrigation controller based on thermal sensing of plant stress. [5]

1.2. Research gap

Because of its attractive, long-lasting flowers, Anthurium is popular as both an exotic cut-flower crop and as a flowering potted-plant crop. As a crop-plant Anthurium is planted inside green- house environments by growers. [10] Anthurium is an economically beneficial plant for growers. Anthurium plant can affected by fungal, bacterial and viral diseases. These diseases cause heavy loss of the harvest of the plantation. So as a solution for that, proposed system is designed to reduce the risk of losing of harvest of the plantation.

When consider about the plant diseases detection systems, currently no any systems can be found on Anthurium plant disease detection. And it is economically very beneficial to have a system like that in case of Anthurium as it's very important economic flower in export potential as well.

Most of the researches that have been done on plant disease detection hasn't focused on the external factors such as humidity, temperature and sunlight level which affect for the healthy growth of the plant.

Currently implemented systems has only focused on disease detection of the plant. But proposed system is not only considering about the diseases that a plant has, but also proposed system is capable of predicting the growth of the plant by analyzing humidity, temperature and sunlight level inside the green-house environment. In current literature context, there are some researches have done on growth monitoring of the plants, but not growth and disease detection features together has implemented in any of those researches.

Disease detection is done by analyzing an image using image processing techniques. Most of the time currently done researches has taken images of leaf, stem or fruit. Image of a one plant is being analyzed and the disease detection is done.

So those systems cannot be used for plantations in real world. Since in a plantation taking one by one picture of plants are practically impossible, those systems are not real applicable solutions. But proposed system is applicable for real world applications. It can be used by growers to early detection of diseases and also for growth prediction

purposes. By using a high-quality camera an image of whole plantation is taken then by analyzing each of the plant this proposed system can give the prediction.

Title	**Publicat-ion & Year**	**Author**	**Crop/ plant**	**Consider Growth of the Plant**	**Possibility to use in a real plantation**	**External factors considered**
Potato leaf diseases detection and classification system.	IJSMC, 2016.	Mr. Girish Athanikar, Ms.Priti Badar	Potato	NO	Weak	NO
An Overview on Detection and Classification of Plant Diseases in Image Processing.	IJSER, 2014.	Nikita Rishi, Jagbir Singh Gill	Cotton leaf spot, Rice plant, Wheat and sugar beet, Orchid leaf, Apple fruit, Chili plant	NO	Weak	NO
Leaf Disease Detection using Image Processing Techniqueue.	IJIREEICE, 2016.	Piyali Chatterjee1, B. Harikishor Rao2	Maize	NO	Weak	NO
Feasibili	IEEE,	Zulkifli Bin	Chili	NO	Weak	NO

ty Study on Plant Chili Disease Detection Using Image Processing Techniques.	2012.	Husin, Ali Yeon Bin Md. Shakaff, Abdul Hallis Bin Abdul Aziz, Abdul Hallis bin Abdul Aziz.				
Digital image processing techniques for detecting, quantifying and classifying plant diseases	Barbedo Springer Plus, 2013.	Jayme Garcia Arnal Barbedo	Vegetable pathology	NO	Weak	NO
Proposed System	Not yet published.		Anthurium	Yes	Excellent	Yes

Table 2. Checking of publications published for Anthurium plant with respect to different factors.

1.3 Research problem

Anthurium plantations are maintain as business at large scale. In plantations, most of the time bacterial, fungal and viral diseases are affects to Anthuriums. Growers most often report two bacterial diseases and three fungal diseases in their commercial greenhouse environments. [10] So when consider about identifying a disease in a large scale plantation, Farmers experience lot of problem in detecting and identifying the diseases. Traditionally farmers identify the diseases by naked eye observation method. [08]

Main reasons for the difficulties faced by naked eye observation method in larger plantations.

Abnormalities at very early stages might not be visible

Sometimes the abnormalities of the plant at the very early stages might not be visible to the naked eye observation method. So, most of the time when a disease is identified in the plantation it has spread up-to some extent in the plantation. So, proposed method has a very clear solution for that, there we use a high-quality camera (Fuji film Fine Pix S8300 compact camera) for image acquisition task.

It takes a photograph of whole plantation at a time on a day. And then it automatically processes and detect whether any disease is being spreading in the plantation. By a noise output system warn the users with state about the cause, disease and prevention methods

Naked eye observation cannot predict the plant growth by considering humidity, temperature and sun light.

Proposed system has the capability of predicting the disease by considering the factors such as humidity, temperature and sun light. So, if any kind of disability of above factors occur in greenhouse environment system identify it and then predictions done using the trained data of neural network. And warn the user by voice output giving predictions and instructions to avoid the unnecessary diseases to be occurred in plantation.

2. OBJECTIVES

2.1. Main Objectives

Main objective of this project is to identify diseases spread among the anthurium as well as to predict diseases can be occurred due to environmental factors like humidity and temperature etc. Main focus is to prevent spreading and occurring diseases which effect the growth of the plant by warning the owners to pay attention.

2.2. Specific Objectives

- **Extraction of features**

  This is one of the most import part of the process in this project. In order to identify the diseases properly through the color changes of the leaves and the flower of anthurium. To extract necessary details method details extraction methods, have to be used. Also, the input image must be a high-quality image in order to identify color variation. All the other processes depend on how the image details are extracted.

- **Detection of diseases**

  Objective of this process is to identify the disease which is spreading. To fulfill this purpose results are taken through two different methodologies. The result is taken and compared with each other and decide which method has the most suitable results for the problem by analyzing the output and take actions accordingly.

- **Predict growth according to the environmental conditions**

  Environmental factors like sun light, humidity, temperature can be taken through different sensor accordingly. These inputs are passed to raspberry pi to process and then predict how the growth can be changed due to the changes in the environment factors.

3. RESEARCH METHODOLOGY

3.1. System Overview

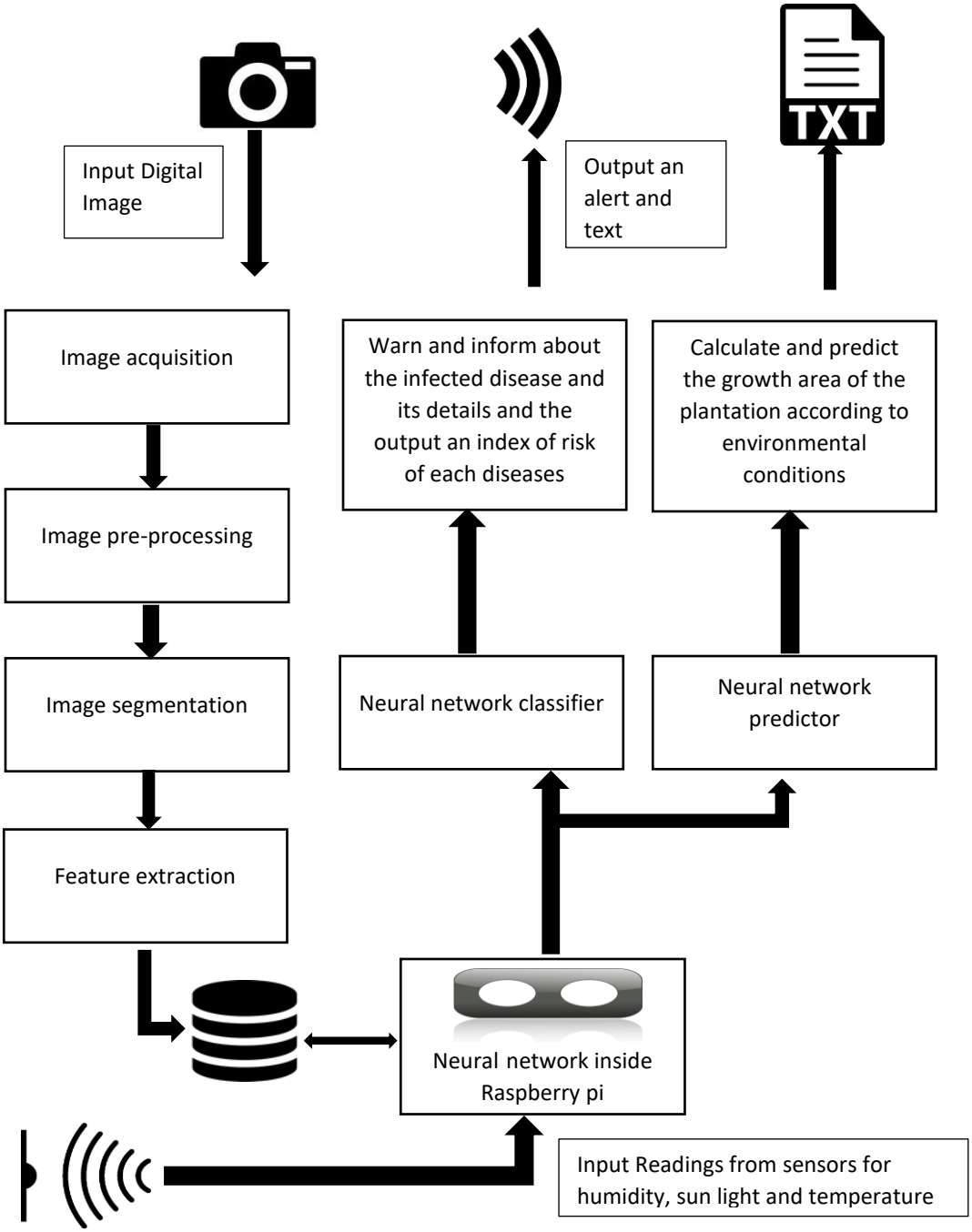

Figure 1: System diagram

3.1.1. Input sample imaging

The healthy and infected parts of the Anthurium plants are used for this study. Spathe, Spadix and leaves of the Anthurium plant is considering for the study respectively. Two data sets of extracted features from images are being used in order to train the neural network. Another data set is used to segment the infected and healthy parts of the Anthurium plant and identify the exact disease using trained neural network.

Each image doesn't contain the single type of leaf/spathe or spadix but the image of the whole plantation. The captured image is zoomed and uses for the next future steps in the study.

In this study, we are monitoring the way of spreading the diseases, color changes by taking the images in every single day.

Here we are considering different types of diseases such as bacterial, fungal and diseases. In order to maintain the accuracy of the system, we are hoping for at least 100 points to capture from images for entire study of diseases.

Different types of both healthy and infected parts of the Anthurium plant (spathe, spadix and leaves) are being considered for the study.

Figure 2: A Healthy Anthurium plant as illustrated in [10, Figure 1]

Bacterial Diseases

- Bacterial Blight

Figure 3 Infected edges of the leaves by Xanthomonas Bacterial blight as illustrated in [10, Figure 3]

Figure 4 Infected spathe of the Anthurium flower as illustrated in [10, Figure 6]

Figure 5 Infected leaf of Anthurium plant by Xanthomonas Bacterial blight as illustrated in [10, Figure 5]

- Bacterial Wilt

Figure 6 Infected Anthurium leaves by Ralstonia Bacteria Wilt as illustrated in [10, Figure 7]

Figure 7 Ralstonia bacteria clogging the vascular system of the plant as illustrated in [10, Figure 8]

Fungal Diseases

- Black Nose Disease

Figure 8 Black nose disease on Anthurium causes spadix darkening as illustrated in [10, Figure 13a]

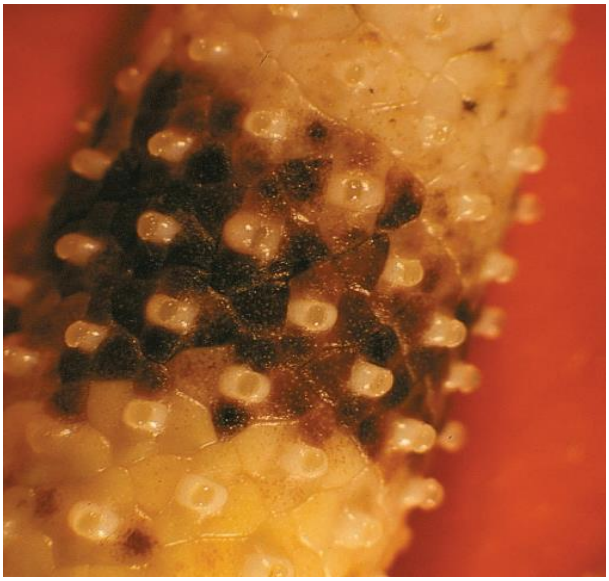

Figure 9 Black nose disease as illustrated in [10, Figure 13b]

Phytophthora/Pythium

Figure 10 Anthurium wilt caused by Phytophthora as illustrated in [10 ,Figure 11]

Root Rot

Figure 11 Anthurium wilt caused by Rhizoctonia root rot as illustrated in [10, Figure 9]

3.1.2. Image aquisition

Image are acquired using digital camera (Fuji film Fine Pix S8300 compact camera). The images are being stored in a personal computer (Intel Core i5). This compact camera has a high quality lens which provides zooming. Camera is mounted over the simple stand which provide horizontal movements to finely tune the position of the camera with respect to location of the Anthurium plant in the plantation.

When capturing the images of healthy and infected plants, we are considering of maintain same distance, capturing images on an exact time period in every single day and under natural sun light and other environmental conditions and the movements of plants in the plantation, is being considered when continuing the project in future steps.

3.1.3. Image pre-processing

Captured images are the most decisive thing for the result analysis and feature extraction. But when taking an image, noise filtering is the most important thing because the image contains the noise due to dewdrops, insects' excrement and dust.

Image pre-processing contains image clipping, image filtering and enhancement.

Image clipping or re-sizing the image is a technique used in image preprocessing for re-sizing to a fixed resolution for easy analysis and reduce the computational burden and improve the storage efficiency in future steps in the study.

Image smoothing is done using various smoothing filtering techniques.

Image enhancement is done by using enhancing the brightness and contrast of the image.

3.1.4. Image segmentation and feature extraction

Both healthy and infected parts of the Anthurium plant like spathe, spadix and leaves are considering for the study. In order to identify the parts of the Anthurium plant as healthy or infected, segmentation techniques help to fulfill that task.

The segmented parts are used to extract features like shape, texture and color for the future steps in the study.

3.1.5. Classifying the disease, measuring its severity and provide with necessary guidelines to minimize the disease-aspect 01

Classification and detection of the disease is done by training an artificial neural network. After classifying, severity of the disease is measured. Classification of the disease is done based on two aspects in the project. Those two aspects are based on the spread of the disease in the plant and based on the color variations of the diseased area.

In this functionality only the spread of the disease aspect is considered. Mainly we consider about the diseases which symptoms can be observed on leaf, spadix and spathe of the plant.

In here by considering, the way the symptoms can be seen, and from where symptoms have started to appear and to where it has spread is considered to detect the disease and the amount of spread across the plant is considered to quantify the severity of the disease.

Different diseases start to show symptoms from different areas of its'(spadix, leaf, spathe) surface. And with the spreading of the disease in the plant, it starts to spread more into the other areas of the plant.

Below shown are images of Spreading of the Bacteria Blight disease in the Anthurium plant.

Figure 12 Water soaked lesions developing at leaf margins as illustrated in [13, Figure 10]

Figure 13 Typical blight symptoms showing necrotic zones surrounded by chlorotic tissues as illustrated in [13, Figure 11]

Figure 14 Interveinal chlorosis on leaves characteristic of a systematic infection as illustrated in [13, Figure 13]

Figure 15 Systematic infection resulting in death of potted plants as illustrated in [13, Figure 14]

According to the Figures (Figure12, Figure 13, Figure 14 and Figure 15) Bacteria wilt start as water-soaked spots visible near the margins where hydathodes, filled with guttation fluid, serve as the most common port of entry (Figure 12). Tissues surrounding the infected areas turn yellow. Water-soaked spots coalesce, eventually forming large necrotic zones at leaf margins (Figure 13). The pathogen quickly moves into vascular tissues of petioles (Figure 14) and stems, Preventing the translocation of nutrients and water and producing symptoms of water stress that may resemble natural Senescence (Figure 15).

So different diseases has its own way of spreading. So by using different way of spreading of different diseases, training of the neural network is being done.

Then identification of the disease is done using trained data of neural network. And It is given to the user as a voice output. Then quantification of the disease severity and the Details of the disease and instructions of the treatments are given to the user.

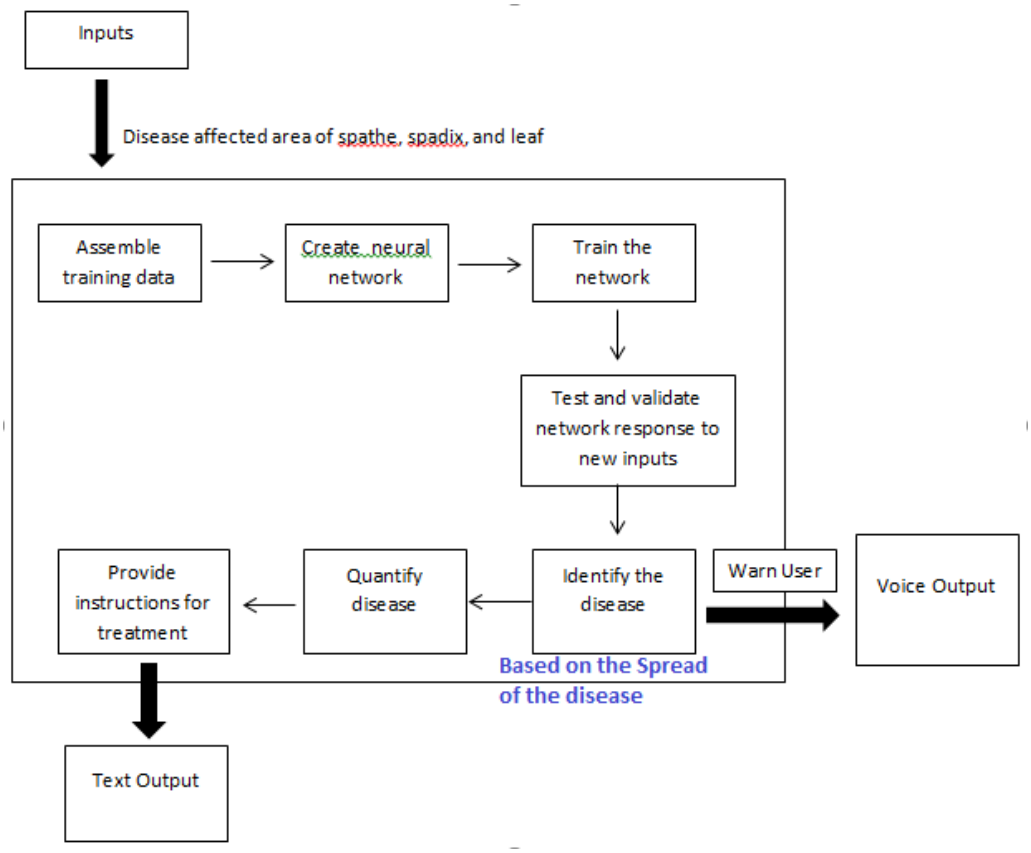

Figure 16 Diagram of classifying the disease using aspect 01

3.1.6. Classifying the disease, measuring its severity and provide with necessary guidelines to minimize the disease-aspect 02

After extracting the features of the spathe, spadix and leaf of Anthurium plant the next step is to classify the diseases, quantifying the severity of the disease which means to determine the rough quantity of the spread of the disease and then warn the user about the disease using an alarm and provide necessary instructions for the growers on how to treat the disease.

This is targeted to be done using an artificial neural network. After the process of extracting different features of the diseased spathe, spadix and leaf, the process of classification part is getting all the extracted data to one place and creating the network. Then training the network using the data collected and finally testing and validating the neural network response to new inputs. We hope to identify at least ten diseases which are bothering and very popular among large scale Anthurium growers. For this process of classification, a data set of infected plant images are taken into consideration. The classification process is evaluated using two aspects namely identifying through color changes of the diseased plant. This can be done by using a fast learning algorithm which is easy to be implemented and has low computational cost. After classification, the quantification is done. Severity may be inferred by the area of the leaf, spathe and spadix that are affected by the disease which can be estimated by means of color and texture features. In the quantifying process, estimation is given as a percentage as it is not efficient even when quantifying the disease manually. Extracted features are properly pre-processed and applied to a quantifying algorithm to determine severity. Then the user is acknowledged with different treatments and pesticides that can be used to minimize the disease using text outputs. This component gives the first clue of what really happens and warn the growers which leads to increase the accuracy of the proposed automatic system.

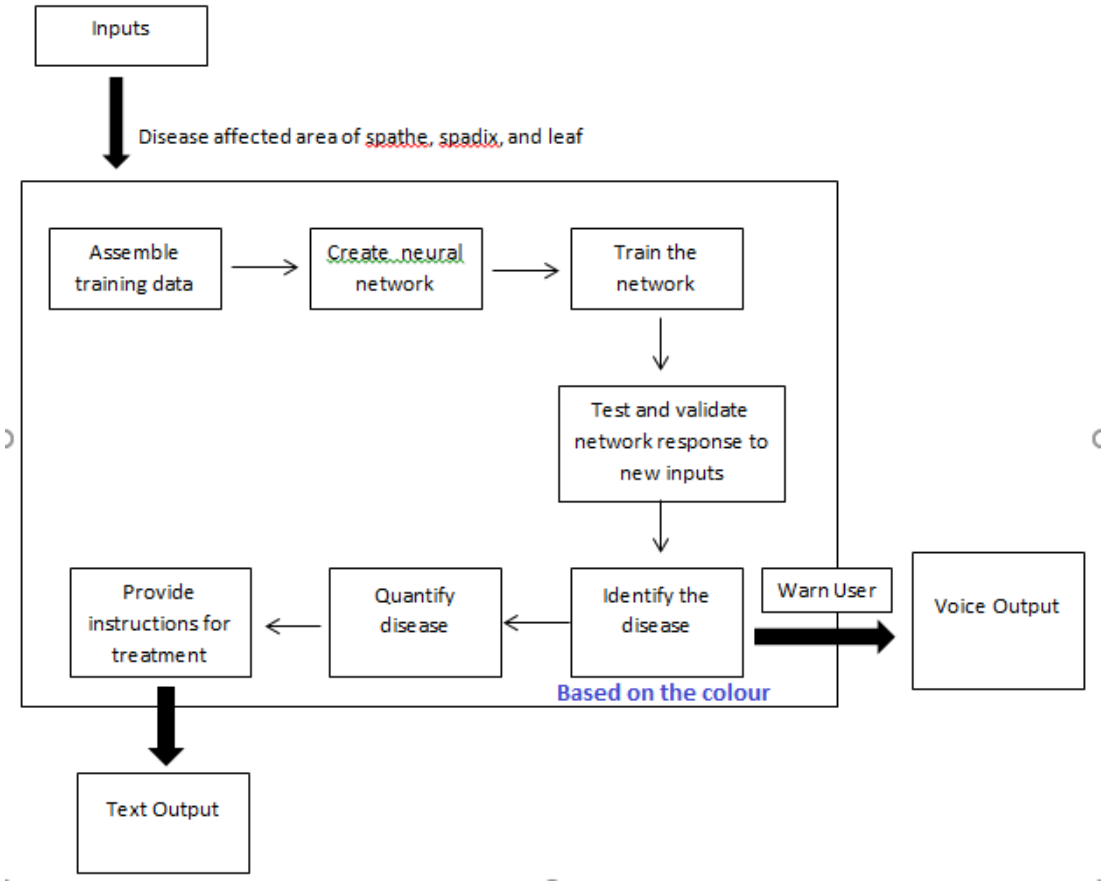

Figure 17 Diagram of classifying the disease using aspect 02

3.1.7. Calculate and predict the growth area of anthurium plantation according to environmental conditions

For the growth prediction, we consider the green area of leaves relative to the environmental factors like sun light, temperature and humidity. Using sensors those factors are taken to a raspberry pi and then processing is done. Then processed data will be stored in the database. And also, using a high-quality camera (Fuji film Fine Pix S8300 compact camera) images are taken and stored. With respective to the prevailing conditions green area of leaves are calculated. Using a neural network with the available details prediction is done and measure how much prevailing factors will effect on the future growth.

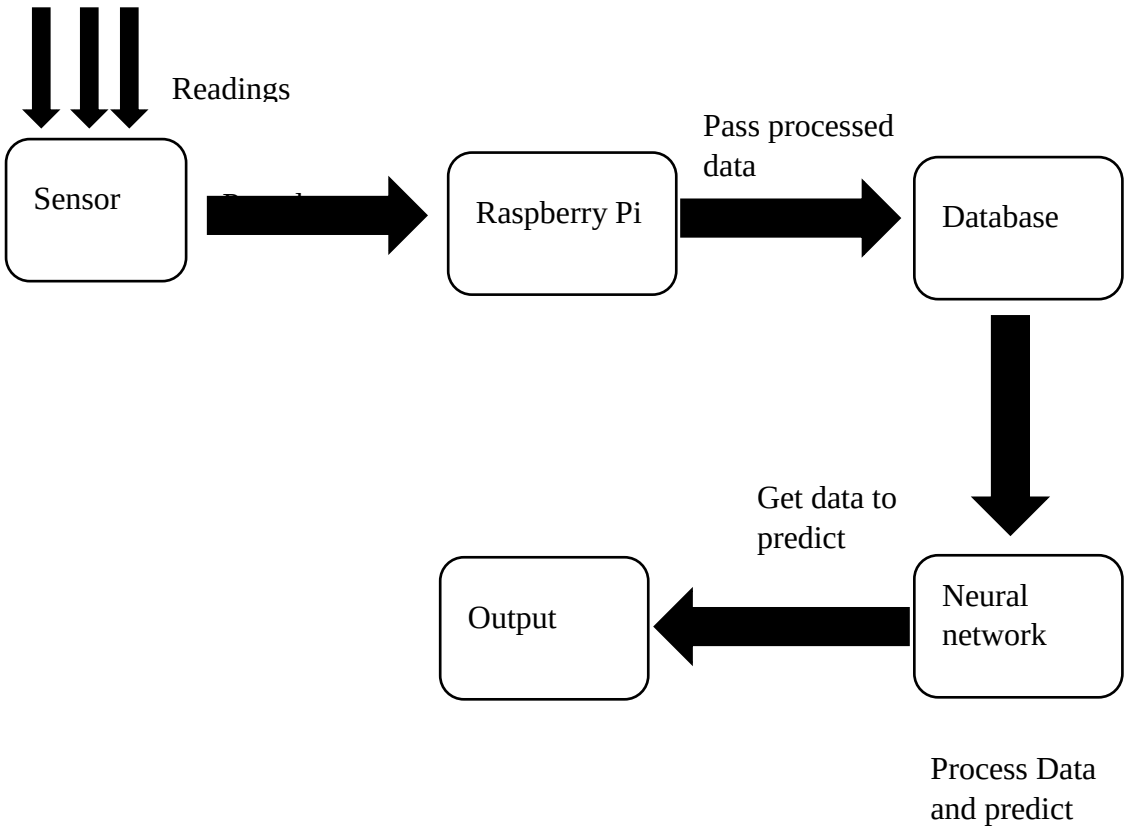

Figure 18 Diagram showing the growth prediction of Anthuriums in the plantation.

Technologies to be used

For the implementation of the system, the following technologies will be used.

Python, OpenCV libraries for image processing and Tensor flow libraries are used for artificial neural network and Mongo DB for data retrieval process. PyMongo as the driver. PyCharm is the IDE used for this particular system implementation.

3.2. GANTT CHART

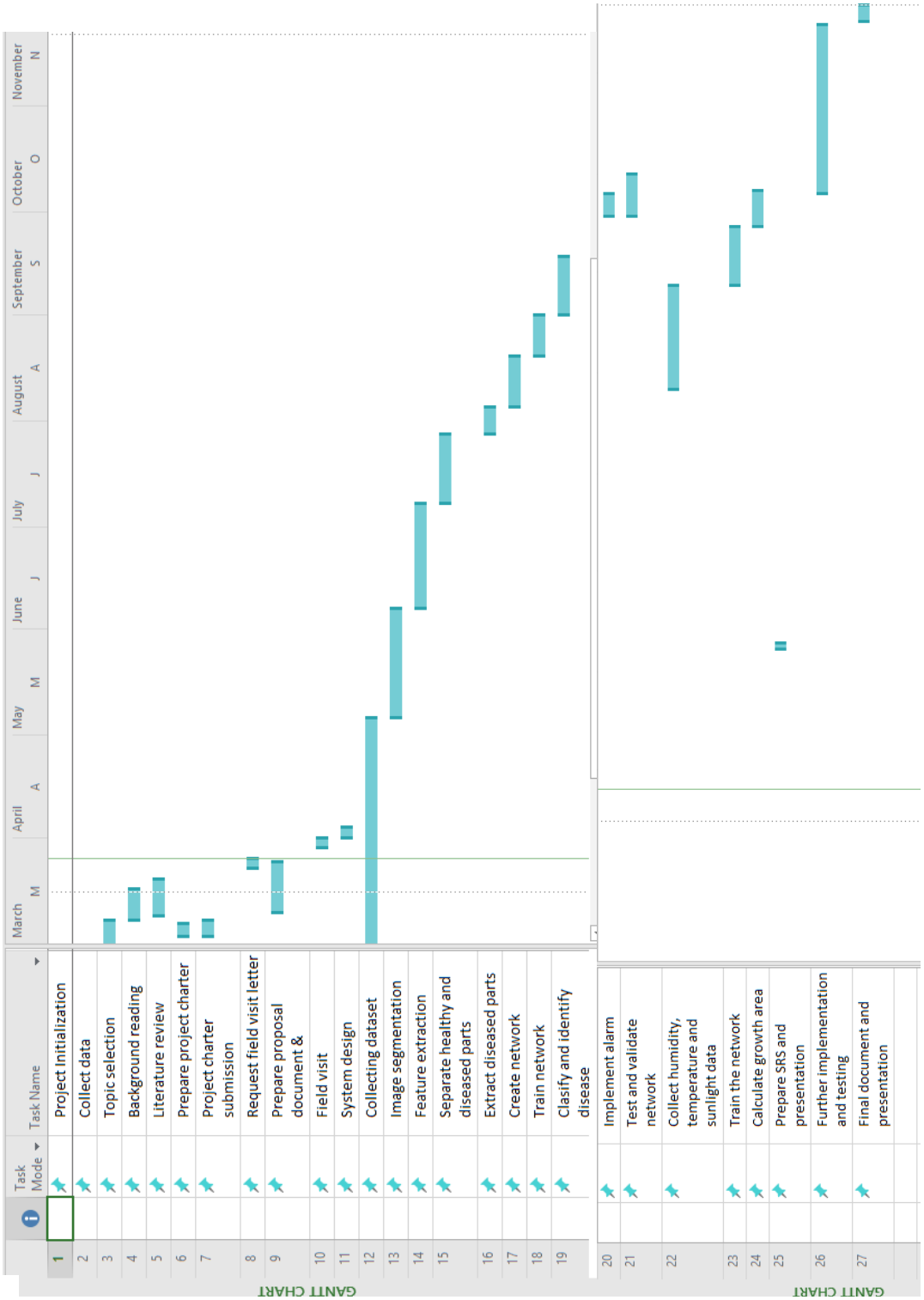

Figure 19 Gantt chart

4. DESCRIPTION OF PERSONALITIES

Member	Component	Task
S.P. Amarasinghe	Image segmentation and feature extraction	• Design user interfaces • Assembling the samples of data set for the study. • Enhancing the quality of image by reducing the noise • Identify the healthy and Infected parts (spathe,spadix,leaves) by segmenting the images • Features extraction
S.S. Amarasinghe	Classifying the diseases based on spread of the disease and measuring its severity and provide with necessary guidelines to minimize the disease.	• Design user interfaces • Assembling the samples of data set for the study. • Creation of a neural network • Test the neural network in order to classify the diseases • Measuring the severity • Provide guidelines from proper GUI
P.D.P Madavika	Classifying the disease, measuring its severity and provide with necessary guidelines to minimize the disease	• Design user interfaces • Assembling the samples of data set for the study. • Train the neural network using extracted features • Test the neural network in order to classify the diseases

		• Measuring the severity • Provide guidelines from proper GUI
R.P.Janith Kularathne	Calculate and predict the growth area of Anthurium plantation according to environmental conditions	• Design user interfaces • Assembling the samples of data set for the study. • Assembling the data sets by monitoring the environment using sensors • Calculate the growth of the plantation according to environmental conditions • Provide predictions from proper GUI

Table 2 Workload Allocations

5. BUDGET AND BUDGET JUSTIFICATION

In order to continue the research, researches need Raspberry Pi and sensors which will cost approximately Rs.4000 and approximately Rs10,000 for the high-quality camera. Camera will be rented for one year period of time. Research is planning to be conducting in Gampaha botanical garden, to continue the study of the research, we need to provide them some resources such as Anthurium plants to get injected the diseases and other expenses for the payments of the workers who are going to co-operate with our study. Therefore, it will cost around Rs.10,000 approximately for those expenses.

Total cost will be around Rs.25 000 approximately according to the recently gathered information.

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