GROWTH PREDICTION, DISEASES DETECTION & CLASSIFICATION SYTEM FOR ANTHURIUM PLANTS

Project Id: 17-082

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Software Requirement Specification

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BSc. Special(Hons) In Information Technology

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The above candidate have carried out research for the B.Sc dissertation under my supervision.

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(Dr. Rohana Thilakumara)

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1.0 Introduction

1.1 Purpose

Agro is a special application implementing for the early disease detection and growth prediction of Anthurium plant. In order to achieve this goal we are developing an standalone application which include features such as,

1. Feature extraction of images of leaf, spadix and flower

2. Anthurium disease detection based on color variation.

3. Detection of Severity level of the Anthurium diseases by considering environmental conditions.

4. Growth prediction of the plant by considering environmental conditions.

This document describes the functionality of detection of severity level of the Anthurium diseases by considering environmental conditions. The purpose of this document is to fully describe the functional and non-functional requirements design constraints, of Risk level detection of diseases functionality proposed for the system. Further, this SRS document contains a detail overview of high-level architecture of the system, purpose and features of the system, the interfaces of the system, user requirements, what the system will do, the constraints under which it must operate in order to obtain optimal results and how the application will react to external factors.

On the whole, this document is written with the purpose of providing a complete description on the behavior of the 'detection of severity level of the Anthurium diseases by considering environmental conditions' functionality. For the better understanding of the above functionality, this document includes its sub components, how each sub component works and the relationship between those sub components to the end users and developers.

The intended audience of this document is the Project supervisor and the research team, but will also benefit the former researchers, developers who will be engaging in developing and maintaining the application in the future and any person, who is interested implementing application for plant diseases in image processing.

1.2 Scope

This document covers the requirement of the initial release of Agro application. This release will mainly support as a warning and an awareness system for cultivators who are maintaining plantations in a large scale, and are waiting for a fruitful harvest from their crop. The section of the project scope which is going to be evaluate from this document can be divide in to following areas.

1.2.1Image segmentation

This functionality provides a definition to feature extraction functionality by identifying whether the particular parts of the plant is healthy or infected. This component helps application to build the features such as predicting the growth area of the plantation and classifying the diseases.

1.2.2 Feature extraction

This functionality provides more detailed attributes to diseases classification and growth prediction functions. Once, a user input an images from the camera in to proposed system this function will extract the features and helps to classify the diseases and predict the growth area of the plantation functions in the system.

1.3 Definitions, Acronyms, and Abbreviations

Acronyms	Definition
Agro	Application Name
IDE	Integrated Development Environment
GUI	Graphical User Interface
SRS	Software Requirement Specification
MS	Microsoft
DB	Data base
SQL	Structured Query Language
IT	Information Technology

Table 1: Definition, acronyms and abbreviations

1.4 References

All the references referred to prepare the SRS document are stated at the end of the document.

1.5 Overview

1.5.1. Main goal of the application

The main goal of the proposing system is to deliver the effective, user friendly warning and awareness system which is a standalone application to acknowledge the cultivators in order to increase the harvest.

1.5.2. Tasks

- Develop more user friendly GUI, in order to understand the proposing system process by cultivators who is lack of knowledge in IT.
- Implement more effective feature extraction facility to classify the diseases more accurately.
- Identify infected or healthy plants in order to extract the features more accurately.

1.5.3. Users

Target audience is the cultivators who is maintaining large scale plantations and is aware of newest technology to increase the harvest and minimize the damage to the crop.

1.5.4 Organization of the SRS

In section 1, the purpose of the preparing the document is explained, the aspects of the application the document tends to cover, the scope of the software, Glossary and an overview of the software, it's main goals, tasks and users are described.

Section 2 describes Overall description of software is explained in a non-technical manner, it includes product perspective, product functions, user characteristics, constraints, assumptions, dependencies of requirements.

Section 3 describes the technical requirements of the software and contains functional requirements, non-functional requirements and design constraints. It also includes the class diagram of the system. 9

Section 4 describes contains supporting information for the readers of this document.

2.0 Overall Descriptions

Agro is a user friendly stand-alone application developed targeting the main users as large scale Anthurium growers. The main target of the application is to warn the users about the spread of the diseases, predict the outbreak of a disease with related to environmental conditions and monitoring the growth of a plantation considering humidity, temperature and sun light. The main problem addressed here are the difficulty in naked eye observation of each and every plant, difficulty in monitoring the plantation growth with the sudden changes in the environmental factors and difficulty in predicting the outbreak of a disease with related to environmental conditions.

The accuracy of the application is expected to be high. The growers can maintain a healthier plantation through the application as it covers every aspect that a grower should see when growing Anthurium currently done through naked eye observation. The security of the application is also very high and newest technologies are uses for implementation process. Therefore users have an opportunity to get familiar with the new technologies through the application.

The description of the functions of the application is as follows.

- 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.

- Growth Prediction

  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. 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.

- Classification and quantification of the diseases

  This functionality is mainly about the classification of a certain disease identified using the color variation of the spots. When interacting with the growers, we found out that for different diseases, the color of the spots are different. The growers also identify the diseases through naked eye observations by the spot color. Since it is difficult to do this with every plant every time, this application helps with the classification process. The application warns the user when some color of a spot has occurred in leaf, spathe or spadix. To quantify the disease means measuring how much the disease has spread throughout the plant. This can be stated as a percentage. 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 in turn leads to increase the accuracy of the proposed automatic system.

- Detection of Severity level of the Anthurium diseases by considering environmental conditions.

  Environmental conditions are a main factor that affects for the healthy growth of a plant. Main environmental conditions that affects for the healthy growth of a plant, are sunlight, temperature and humidity of the atmosphere. In the proposed system, we are considering about these factors and planning to give the severity level for diseases, caused due to the changes of the environmental factors. So for that, by considering past history of data, neural network will predict the diseases that can affects for the plantation and also it will detect the severity level of those diseases.

2.1 Product perspective

There are many related projects and researches that are based on determining the presence of diseases in plants via image processing techniques. But there are some identifiable short comings and disadvantages in the products that we have come across.

When we consider about the researches that have been done so far, in this area, most of these researches have done for crops/plants such as Potato, Tomato, Maize, Orchid, Apple fruit, Chili plant etc. But no any research can be found on, for

Anthurium plant. So, it's one of the major reasons for selecting Anthurium as the plant for this research.

When we look at the researches that have been done so far, we can clearly identify that growth of the plant has not considered, they have only considered about the disease identification and also those products are hard to use in very large-scale cultivations, as those researches have done to analyze a single leaf or tuber.

And also, In the disease identification process of currently done researches, they haven't considered about the external factors such as humidity, temperature and sunlight which are directly affects for the healthy growth of a plant. But this proposed system, consider about the external factors and predicting the severity of the diseases.

Title	**Publicat -ion & Year**	**Author**	**Crop/ plant**	**Consi der Growt h of the Plant**	**Possibility to use in a real plantation**	**External factors consider ed**
Potato leaf diseases detection and classific ation system.	IJSMC, 2016.	Mr. Girish Athanikar, Ms.Priti Badar	Potato	NO	Weak	NO
An Overvie w on Detectio n and Classific ation of Plant Diseases in Image Processi ng.	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
Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques.	IEEE, 2012.	Zulkifli Bin Husin, Ali Yeon Bin Md. Shakaff, Abdul Hallis Bin Abdul Aziz, Abdul Hallis bin Abdul Aziz.	Chili	NO	Weak	NO
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 Comparison of existing system with 'Agro' proposed system

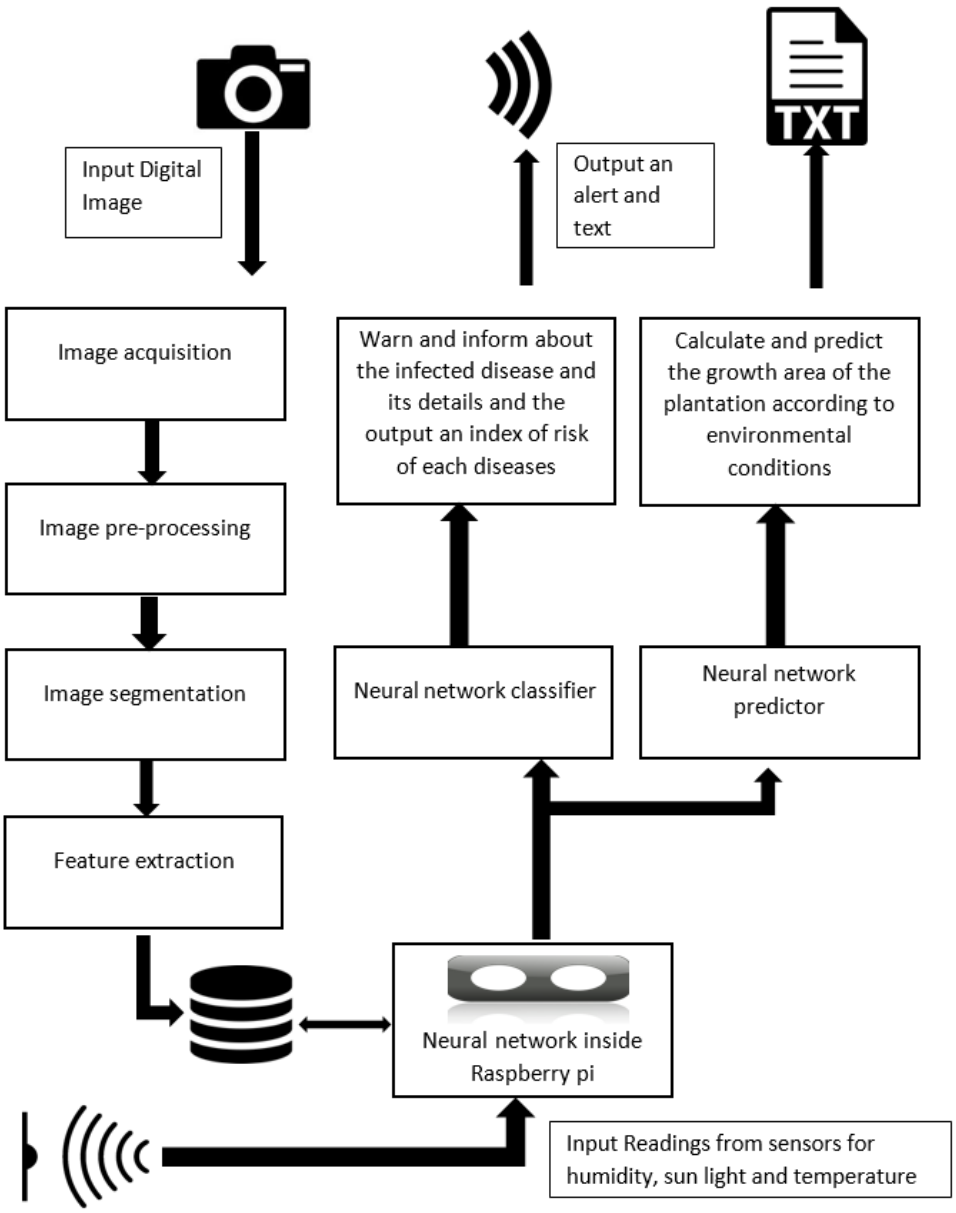

Figure 1 System diagram

2.1.1 System Interfaces

- Standalone application

  A stand-alone application installed in a personal computer or a laptop with Windows 8 or above which user can use anywhere easily.

- Database

  A proposed database (MongoDB) is intended to store, retrieve, update and handle the data input by the user and generated by the system itself. This database includes the processed images acquired from the camera and the sensor readings of the environmental factors sunlight, humidity and temperature.

- Integrated Development Environment (IDE)

  An IDE that supports Python 2.7 language should be used. PyCharm is the IDE used for the development (coding) process.

- Library for image processing

  OpenCV (Open Source Computer Vision) is the library used for image processing. There are bindings available in Python language. This runs on a variety of platforms including Windows.

- Library for machine learning

  TensorFlow is the library used for the functions associated with neural networks. It is an open source software and supports Python 2.7.

2.1.2 User interfaces

The user interfaces of the application and how the user interacts with the system are clearly described in the section 3.1.1 of the document.

2.1.3 Hardware interfaces

- A personal computer or a laptop with windows 8 or above installed.
- Sensor DHT22 - Sensors are needed to get the readings of environmental factors namely temperature and humidity.

  A sensor capable of measuring sunlight is used to get the readings of prevailing sunlight.
- Raspberry Pi 3b - A raspberry pi is necessary to store data taken from sensors
- Fuji film Fine Pix S8300 compact camera - High-quality camera is necessary for image acquisition process for further development of the application.
- SD card – A SD card is used to retrieve data from the raspberry pi and store in the database. This is a non-volatile memory card which can be used in personal computers and laptops.

2.1.4 Software interfaces

- Database

  MongoDB is used for database. It is a free and open source cross platform document-oriented database program. Advantages of using MongoDB is that it does not have complex joins and easy to scale. It also has fat in-place updates. MongoDB is accessed through a driver called PyMongo.
- Integrated Development Environment (IDE)

  PyCharm is the IDE used for the development process. This the best IDE version used for programming in Python language. This has special features like code analysis, a graphical debugger and an integrated unit tester.

2.1.5 Communication interfaces

Agro desktop application does not need specific communication interfaces as this is a stand-alone application.

2.1.6 Memory constraints

Minimum 1GB of Virtual Memory (RAM) and 1GB of Memory Space (Secondary Memory) will be required.

2.1.7 Operations

By clicking ‘classification results’ button in the Main page, user can navigate to classification page. There user can upload an image, after upload the image user should save the image, for upload it the database.

Then user can click ‘Results’ button to get the information about the disease, cause and about the treatments.

By clicking “Severity’ button user can get the information about the severity of the diseases that have affected into the plantation. These are the basic operations user can perform in the application.

In the severity detection functionality, user only need to upload an image of the plantation, user doesn’t need to enter environmental factors (Relevant information of temperature, humidity and sunlight) of the image uploaded by manually. That information relevant to the uploaded image will be automatically captured by the system. All the reading of the sensors will be going to stored inside the Raspberry pi. So, system will have the capability of identify the temperature, sunlight and humidity information automatically, by using the time and the date of the uploaded image was taken. And also inside the raspberry pi, all the sensor readings will be stored respect to the time and the date of the environmental factor changes happened.

So user doesn’t need to worry about giving the environmental factors by manually, as most of the time user is a novice user, system will have the capability of getting the environmental factors and do the prediction automatically.

So above mentioned basic functions, are the operations that user can perform in the application.

2.1.8 Site adaptation requirements

To install and run the application user needs a computer with windows 8 or higher, 1GB of RAM and 1GB of hard space, raspberry pi model 3, digital camera with 8GB memory.

2.2 Product functions

The following use case diagram describes the functions that a user can perform in the Severity level detection of diseases functionality.

- Use case diagram

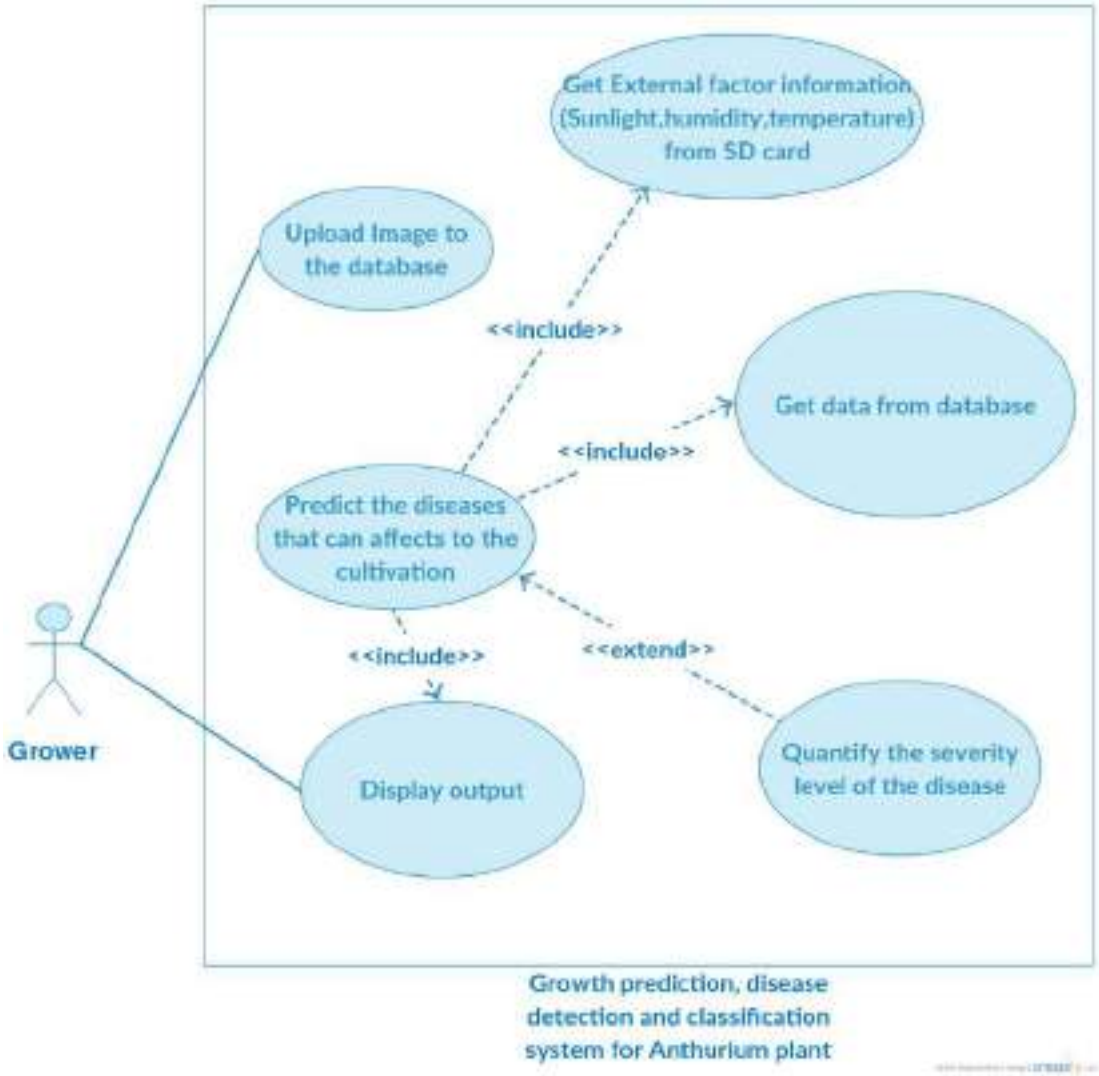

Figure 2 Use case diagram of detection of severity level of the diseases by considering environmental factors functionality

- Use case scenario

Use case name	Upload image.
Pre-conditions	User has the entire system without any failure in working.
Post-conditions	Image is uploaded into the database successfully.
Primary actors	Grower
Main success scenario steps	1. The use case begins when user goes to the main page of the 'Agro'. 2. Click classification tab in the main page. 3. Click 'upload' button. 4. The use case ends when the user click 'Save' button and when the image is successfully uploaded into the database.
Alternatives	4.a.1. If image saving not successfull, system will give a error message and prompts to save again.

Table 3Use case scenario of classification and the severity detection functionalities

Use case name	Display output
Pre-conditions	User has the entire system without any failure in working.
Post-conditions	Prediction of the disease and severity of the disease has displayed successfully.
Primary actors	Grower
Main success scenario steps	1. include ::(Upload image) 2. Click Result button to show the disease, cause and the treatments. 3.Click severity button to display the severity of the risk of the disease. 4. The use case ends when prediction result displayed successfully.
Alternatives	2.a.1. System will display error message, since the system lacks of past history data for the disease identification. 4.a.1. System will display error message, since the system lacks of past history data for the severity detection.

Table 4Use case scenario of display output functionality

2.3 User characteristics

This system is targeted for large scale Anthurium cultivators. Therefore it does not have complicated user interfaces. A person who has a very less amount of IT knowledge(novice) will also be able to use this easily as this is very user friendly.

2.4 Constraints

In order to use this application user should have raspberry pi with minimum model 2 and a pc or a laptop with windows 8 or higher with space of 5GB of free space. Users need internet connection to connect with the database and get the access for the images available.

This software will target on Anthurium plant growers specifically. So the complete system will be developed using open source technologies (MongoDB, Open source SDK etc.).

Since the users are not well experienced and lack of knowledge about the IT field, the application must be developed in a user friendly manner. All the outputs must be given to the user in a simple form in order to understand them easily.

2.5 Assumptions and dependencies

All the personal computers or laptops using this application should install windows 8 or higher operating system to successfully run the application efficiently.

2.6 Apportioning Requirements

The requirements described in sections 1 and 2 of this document are referred to as primary specifications; those in section 3 are referred to as requirements (or functional) specifications. The two levels of requirements are intended to be consistent. Inconsistencies are to be logged as defects. In the event that a requirement is stated within both primary and functional specifications, the application will be built from functional specification since it is more detailed.

'Essential requirements' (referred to in section 3) are to be implemented for this version of 1.1. 'Desirable requirements' are to be implemented in this release if possible, but are not committed to by the developers. It is anticipated that they will be part of future release. 'Optional requirements' will be implemented at the discretion of developers.

The interfaces mentioned in section 3 might be changed in the future, other than that this application will only have slight changes in the development process of this application.

3.0 Specific requirements

3.1 External interface requirements

3.1.1 User interfaces

This interface is the Main interface. User first access this page when accessing the Agro application. This interface is a common interface in the application. By clicking ‘classification results’ button user can navigate to classification page which is shown below. By clicking ‘prediction results’ button user can navigate to prediction result page.

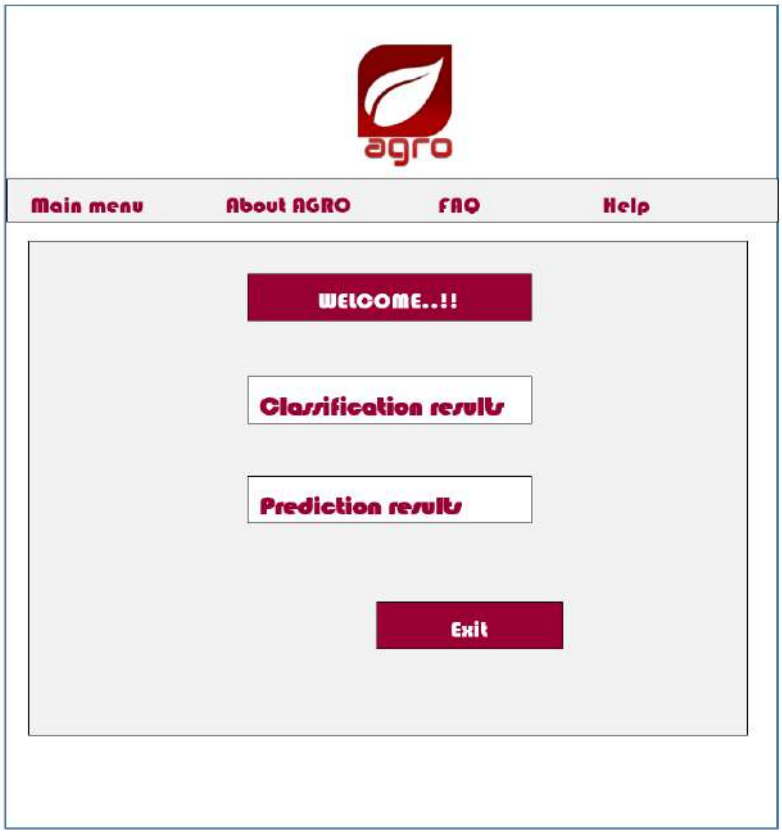

Figure 3 Interface of the main page of Agro

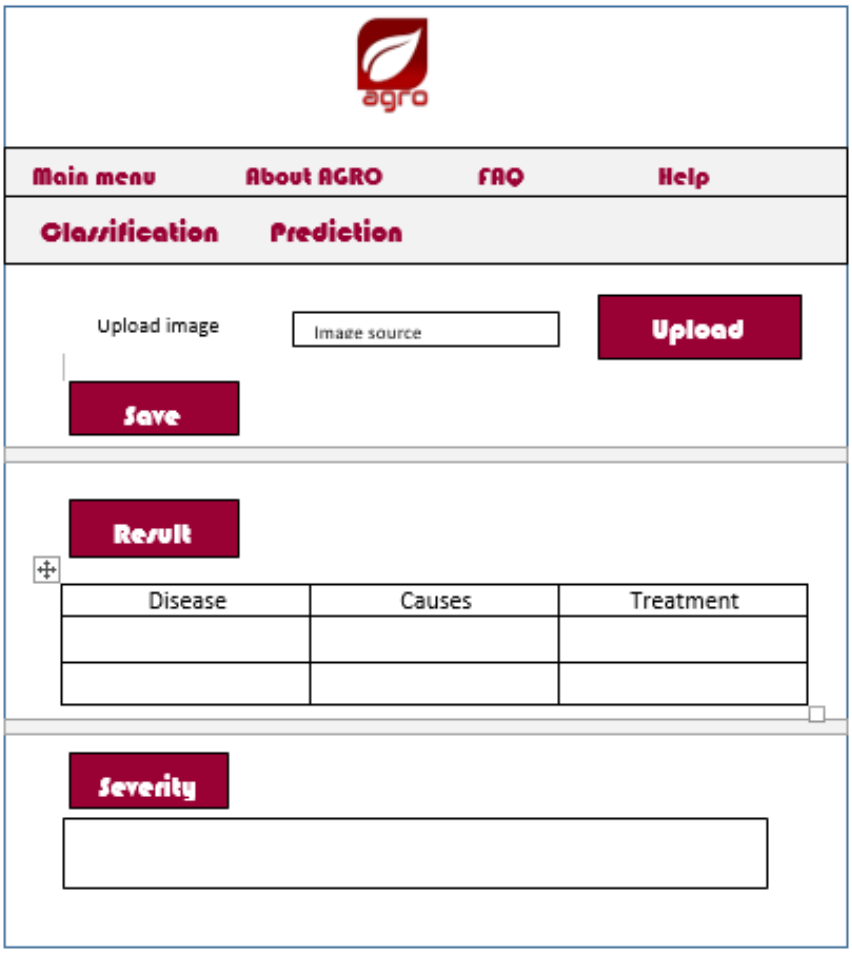

Figure 4 Interface of the disease classification and severity detection functionalities

This interface is related to the disease classification, quantification, severity measurement of the disease and providing causes of the disease, necessary instructions to minimize the disease functionalities. After warning the user that a disease has spread in the plantation, user can get an idea of other aspects related to the disease. When user uploads an image with a disease and clicks on "Result" button, name of the disease, causes and treatments are given. This is mainly done through identifying the color of the spot. Then when he clicks on "Severity" button, the severity of the disease is shown as a percentage.Therefore the user can get a rough idea on how much pesticides or fertilizer that should be used to treat the disease. This interface is very user-friendly and can be easily handled by growers even for a person with minimum IT knowledge, who are eager to get the assistance of technology for their carrier. (These interfaces might change slightly in the future.)

3.1.2 Hardware interfaces

All the hardware interfaces are described in section 2.1.3 of the document.

3.1.3 Software interfaces

For the implementation of the desktop application, several open source software interfaces will be used. The following illustrates the software interfaces used for each module of Agro stand- alone application.

For image segmentation and feature extraction process OpenCV image processing libraries are using for the implementation and Tensor Flow libraries for artificial neural network implementations will use for the system.

PyCharm IDE for python 2.7 will use for MongoDB database and PyMongo driver is using for the database access process.

3.1.4 Communication interfaces

As mentioned in section 2.1.5, Agro does not need any specific communication interfaces.

3.2 Classes/Objects

The below part of the UML diagram is drawn only for the 'Detection of Severity level of the Anthurium diseases by considering environmental conditions' functionality.

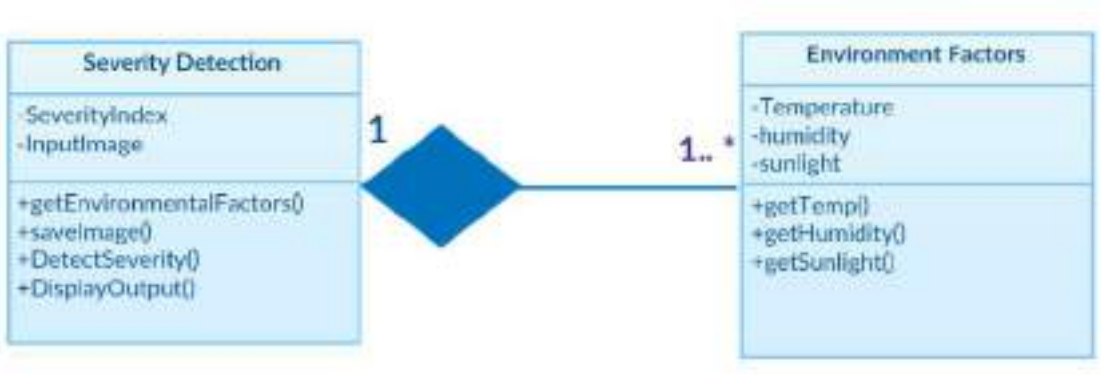

Figure 5Class diagram of 'Detection of severity level of diseases by considering environmental conditions' functionality

3.3 Performance requirements

Since the application runs in the background, considerable resources will be allocated, and hence a personal computer or a laptop with significant amount of RAM (at least 2 GB) will be required for smooth usage of the software. Application should not freeze while working.

3.4 Design constraints

The GUI s are developed attractively and in a user friendly manner, to attract users to the application at their first sight ,and also GUIs should be very simple and easy to understand, So that even users with a very less amount of IT knowledge can use the software application easily.

3.5 Software system attributes

3.5.1 Reliability

Agro stand-alone application will provide its service to users without any issue affecting their satisfaction of the software. It will work according to its specifications. Since users dealing with the application expect something more than doing it manually, the accuracy of the outputs should be high.

3.5.2 Availability

Stand-alone application will work 24x7 and can be used by the users at any time without any issue. Since this is a stand-alone application, no internet connection is needed. Therefore no Wi-Fi related issue will occur.

3.5.3 Maintainability

It will be easy to maintain since it will be developed in the ways it can be extended in future versions and because it is not a complex software. To eliminate issues due to poor coding standards, we are using a common coding standard.

3.5.4 Security

Since the application uses Mongo DB, it provides security to data by creating role based access control mechanism, and can run Mongo DB with dedicated user and provides back up mechanism to your data also.

1.4 References

[1] G. Athanikar, P. Badar "Potato Leaf Diseases Detection and Classification System"International Journal of Computer Science and Mobile Computing, Vol.5(2),pp.76-88, February 2016.

[2] N. Rishi1, J.S. Gill "An Overview on Detection and Classification of Plant Diseases in Image Processing",International Journal of Scientific Engineering and Research.[online]Available:http://www.ijser.in/archives/v3i5/15051503.pdf cotton leaf [Accessed : March 27,2017].

[3] P. Chatterjee , B.H. Rao. " Leaf Disease Detection using Image Processing Technique ",International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering,Vol. 4, Issue 9, September 2016.

[4] Z.B. Husin, A. Y. B. Md. Shakaff, A. H.B. A. Aziz,R.B. S. Mohamed Farook"Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques",Sch. of Comput. & Commun. Eng., Univ. Malaysia Perlis, Kuala Perlis, Malaysia.

[5] J.Barbedo"Digital image processing techniques for detecting, quantifying and classifying plant diseases"December, 2013[online].Available: http://link.springer.com/article/10.1186/2193-1801-2-660.[Accessed : March 27,2017].

4.0 Appendices

- Activity diagram

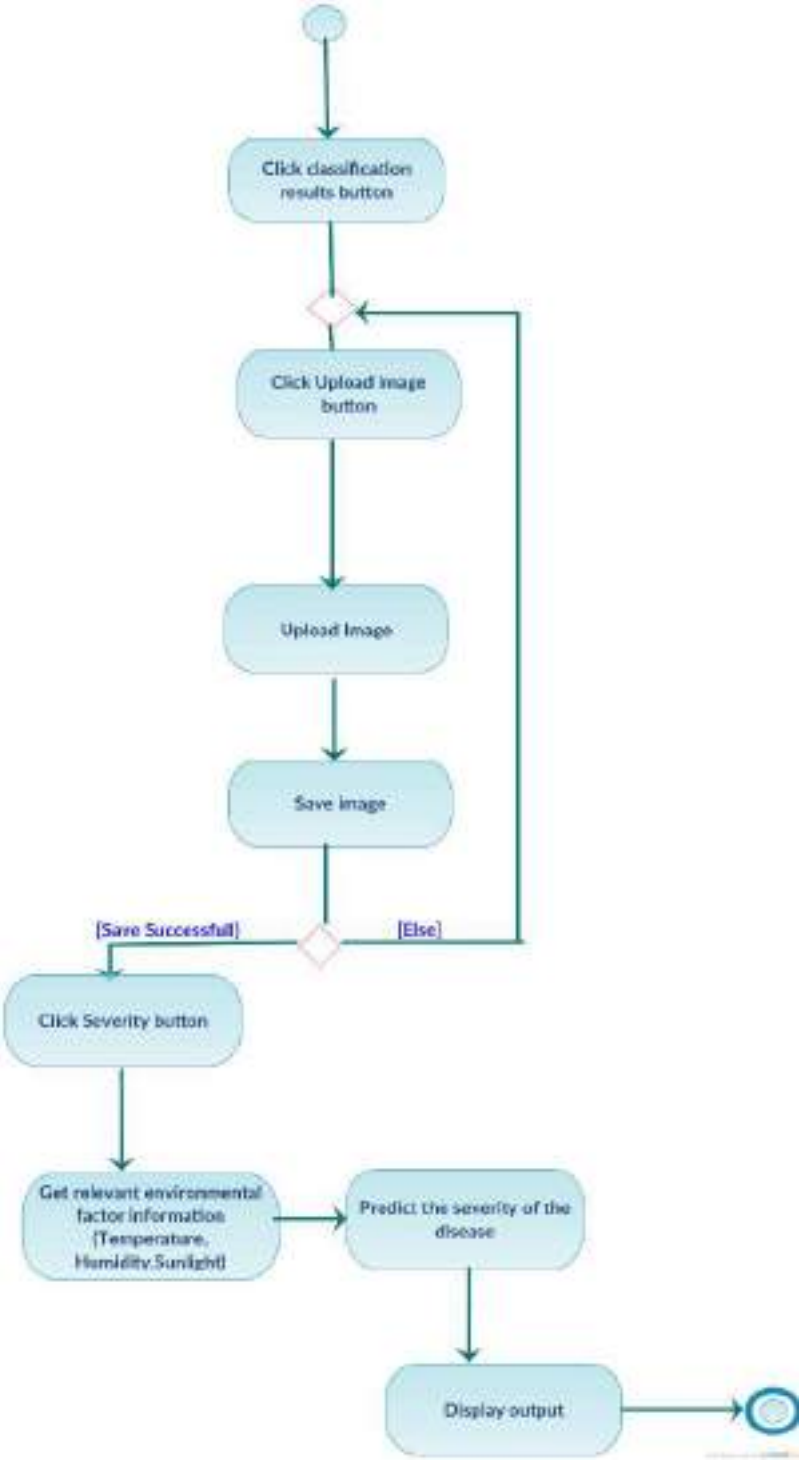

Figure 6 Activity diagram for the 'Detection of Severity level of the Anthurium diseases by considering environmental conditions' functionality