

GROWTH PREDICTION, DISEASES DETECTION & CLASSIFICATION SYTEM FOR ANTHURIUM PLANTS

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Software Requirements Specification

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System For Anthurium Plants.**

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Declaration

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The above candidates have carried out research for the BSc dissertation under my supervision.

Signature of the Supervisor

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(Dr. Rohana Thilakumara)

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1. Introduction

1.1. Purpose

Agro is a special project to provide an efficient, user friendly warning and awareness system for cultivators who is waiting for a fruitful harvest from their crop. In order to achieve this goal, Agro, the proposed system are going to develop with the features such as

1. Classifying the diseases and its severity using colour variations
2. Output an index of risk for various diseases according to environmental conditions.
3. Predicting the growth area of the plantation according to environmental conditions.

This document described about the feature extraction up to image segmentation functionality and it explains how it helps to develop the above main features in the proposed system. And also document described about the both functional and non-functional requirements of the proposed system. Further this explains the 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 identifying the diseases and extraction of features functionality of the special warning and awareness system for the cultivators, which is going to be the final outcome of our research. For the better understanding of the above features, 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. This document 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 in implementing warning and awareness applications for cultivators who is maintaining the Anthurium or any other plantation in a large scale.

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.

1.2.1. Image 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	Definitions
Agro	Application name
SRS	Software Requirement Specification
GUI	Graphical User Interface
IT	Information Technology
IDE	Integrated Development Environment
DB	Database
SD Card	Secure Digital Card

Table 1 Definitions, 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 maintaining large scale plantation and 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 document has been explained, 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. Section 4 describes contains supporting information for the readers of this document.

2. Overall Descriptions

2.1. Product Perspective

In general, cultivators who are maintaining large scale plantations, always trying to minimize the damage to the crop by using technological inventions have faced for different issues due to **lack of facilities in one package and difficulty of applying these inventions in a large scale plantations**. Many researches have been done for the identification of diseases, classification of diseases and predicting the growth area of the plantation in research domain.

They can be explaining as follows,

Title	Publication & Year	Author	Crop /Plant	Consider the prediction of the growth of the plant	Possibility of applying to a larger scale plantations	Consider the environmental factors
Potato leaf diseases detection and classification system.	IJSM C, 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	IJIRE EICE, 2016	Piyali Chatterjee, B. Harikishor Rao	Maize	No	Weak	No

Processing Technique						
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 SpringerPlus, 2013.	Jayme Garcia Arnal Barbedo	Vegetable Pathology	No	Weak	No
Agro	Not yet published		Anthurium	Yes	Excellent	Yes

Table 2 Feature comparison table

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 used 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 considered 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 respect 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 colour variation of the spots. When interacting with the growers, we found out that for different diseases, the colour of the spots are different. The growers also identify the diseases through naked eye observations by the spot colour. 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 colour 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.

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.

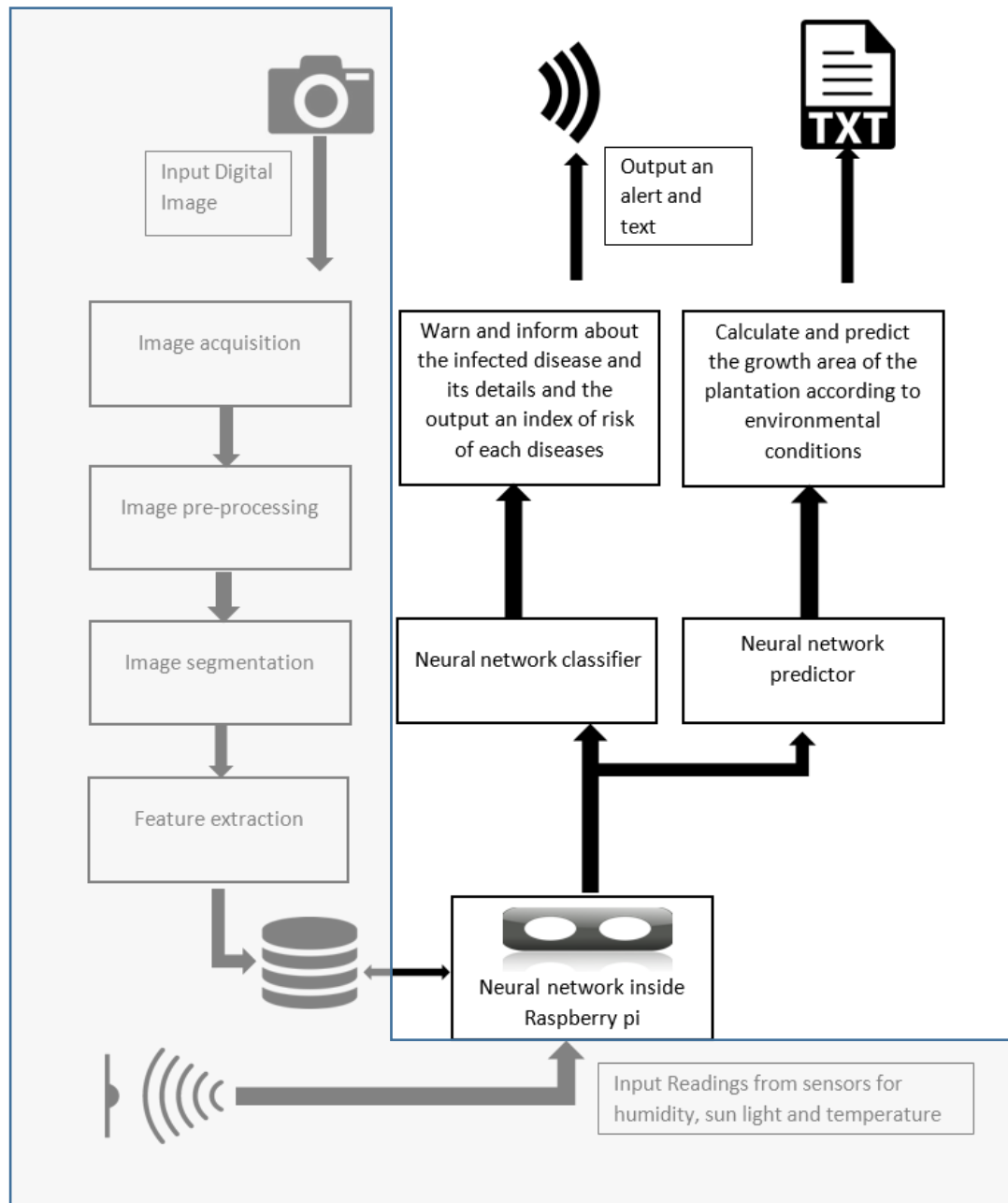


Figure 1 High level diagram of the application

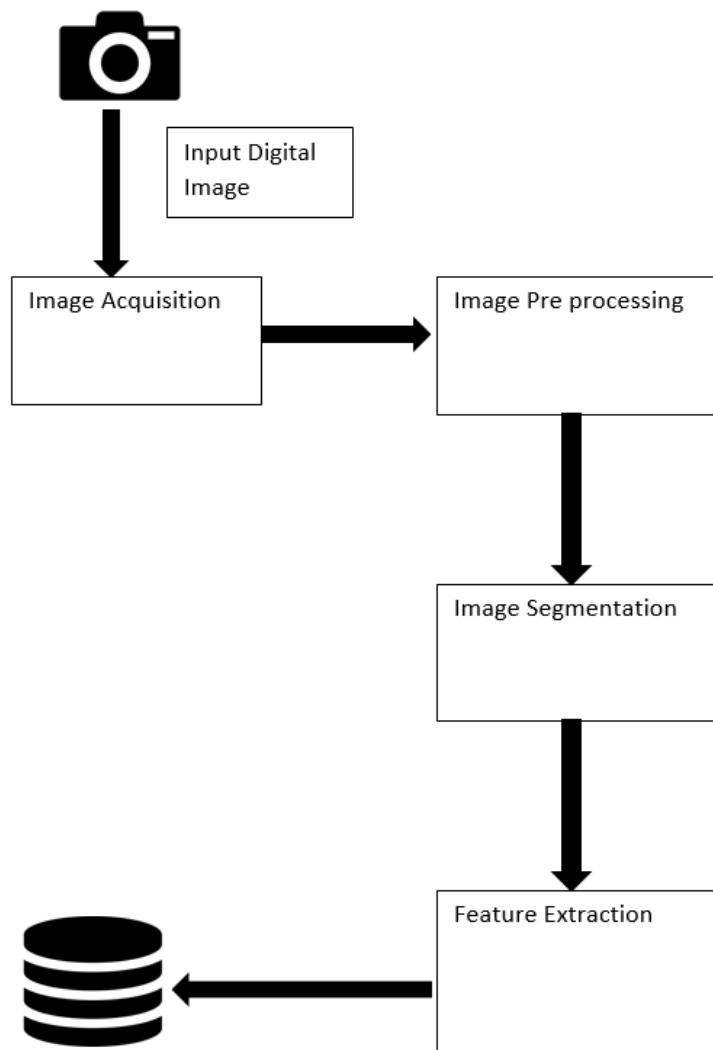


Figure 2 High level diagram of the image segmentation and feature extraction

2.1.1. System Interfaces

This proposed system is come into the user's hand as a standalone application installed in a personal computer or laptop which user can use anywhere easily. A standalone application for windows platform. Because Windows is the most commonly uses operating system among most of the people.

- 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

MongoDB is the database that is used to run Agro desktop application because it has high security and has implemented using latest technology. PyMongo is the driver used for database accessing process.

PyCharm is the IDE which is the application uses for the implementation.

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

This system's main target audience is the people who are lack in IT knowledge and but they are eager for having newest technological solutions to have the best results to their business.

So for that we have develop the application very useful manner in order to have the results that they want very efficiently and user friendly manner.

In order to predict the growth of the plant and classify the diseases, image segmentation and feature extraction process is very much affected to its final outcome.

First user is going to upload the image to the system and uploaded image is save in the DB after an image processing process.

Then image is going under a preprocessing process by resizing image in to a fixed resolution, filtering process in order to increase the brightness and contrast of image to clearly identify the parts of the plants. Image restoration process is to eliminate image noises. Preprocessed image is then going to be segmented whether it is healthy or infected.

Image segmentation process and feature extraction

If healthy it is going to be extracted whole part of the image. If infected it is going to be extracted only infected parts of image and then features are going to be extracted in order to usage of future steps in the system. Colour, texture and shape are the features mainly going to be extracted by the system.

In order to maintain the accuracy some added features may be extracted by the system. But basically above features are the main features can be documented.

2.1.8. Side adaptation requirement

User interfaces are exist only in English language.

2.2. Product functions

The following use case diagram the functions that a user can perform in image segmentation and feature extraction functions.

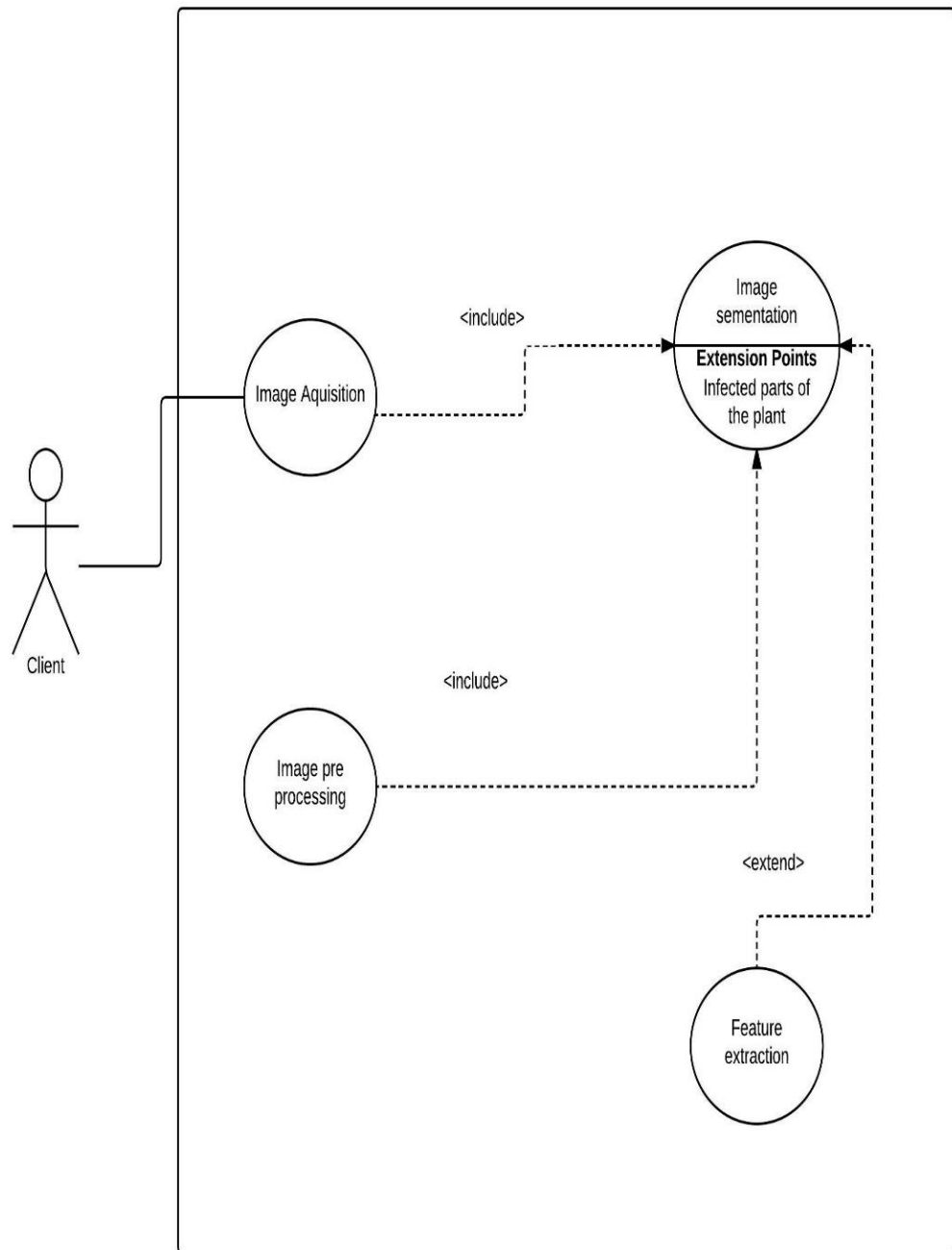


Figure 3 use case diagram for image segmentation and feature extraction

Use case scenarios

Use case name	Image Acquisition
Actors	Field officer, Cultivators, Researches
Pre-condition	User must select upload an image button
Flow of events	<ol style="list-style-type: none"> 1. User select the image 2. Upload the image 3. System sends the image to the backend for further processing. 4. Image is save in the database.
Extension	<p>1a 1. If user selects an invalid file type, system generates an error message.</p> <p>3a 1.Image is resizing. 2.filtering 3.restoration 4.segmentation 5.extracting features.</p>
Post condition	Image is identified as Infected/Healthy and then features are extracted.

2.3. User characteristics

This system is targeted for large scale Anthurium cultivators and who are looking for dealing with newest technology. Therefore it does not have complicated user interfaces. A person who has a very less amount of IT knowledge 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 field, the application must be developed in a simple 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 change, other than that this application will only have slight changes in the development process of this application.

3. System Requirements

3.1. External Interface Requirement

3.1.1. User Interfaces

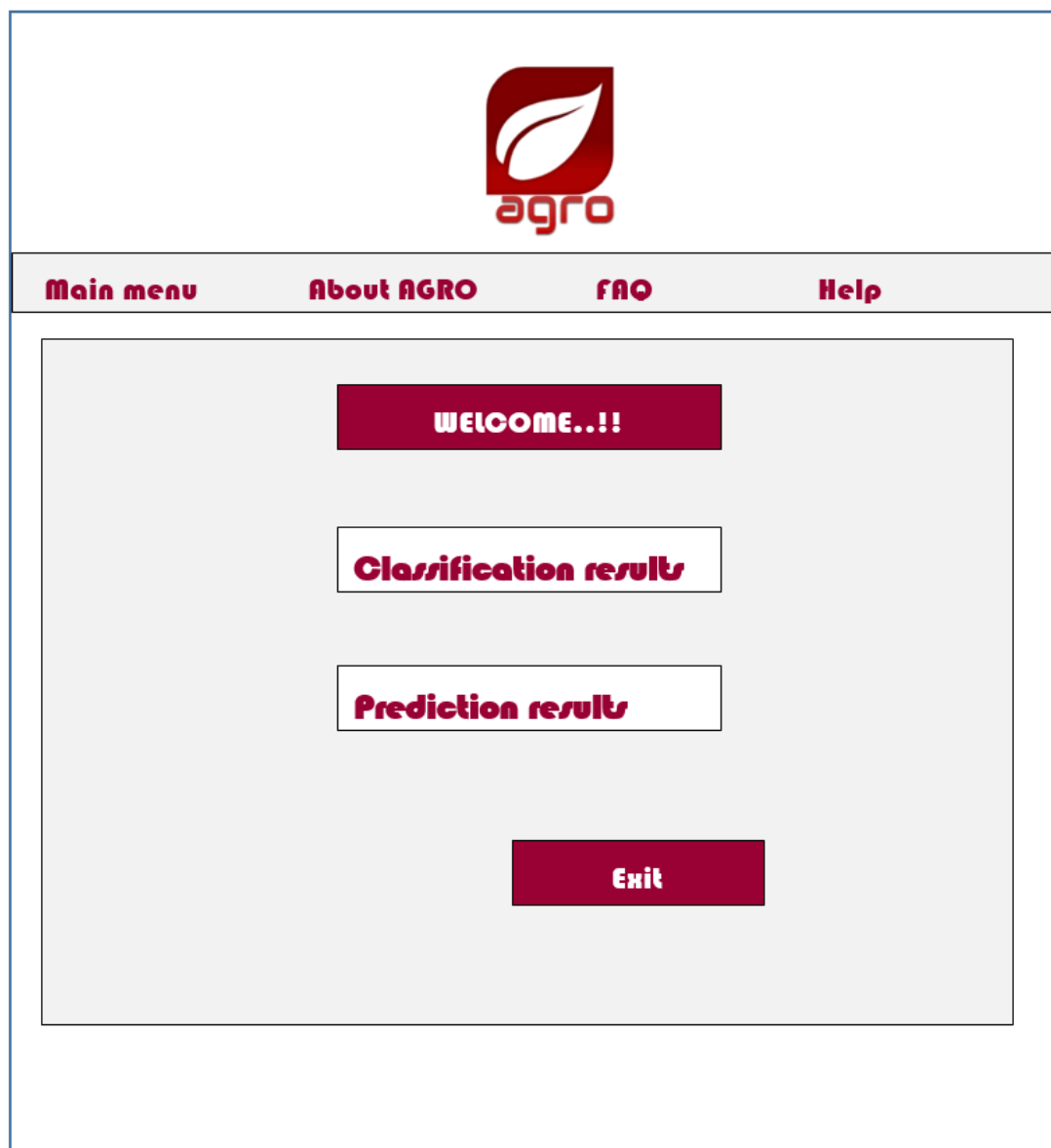



Figure 4 Home page of Agro application



Main menu

About AGRO

FAQ

Help

Classification

Prediction

Upload image

Image source

Upload

Save

Result

Disease	Causes	Treatment

Severity

Figure 5 Interface for upload image for image segmentation and feature extraction functionality

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 TensorFlow 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 image segmentation and feature extraction functionality.

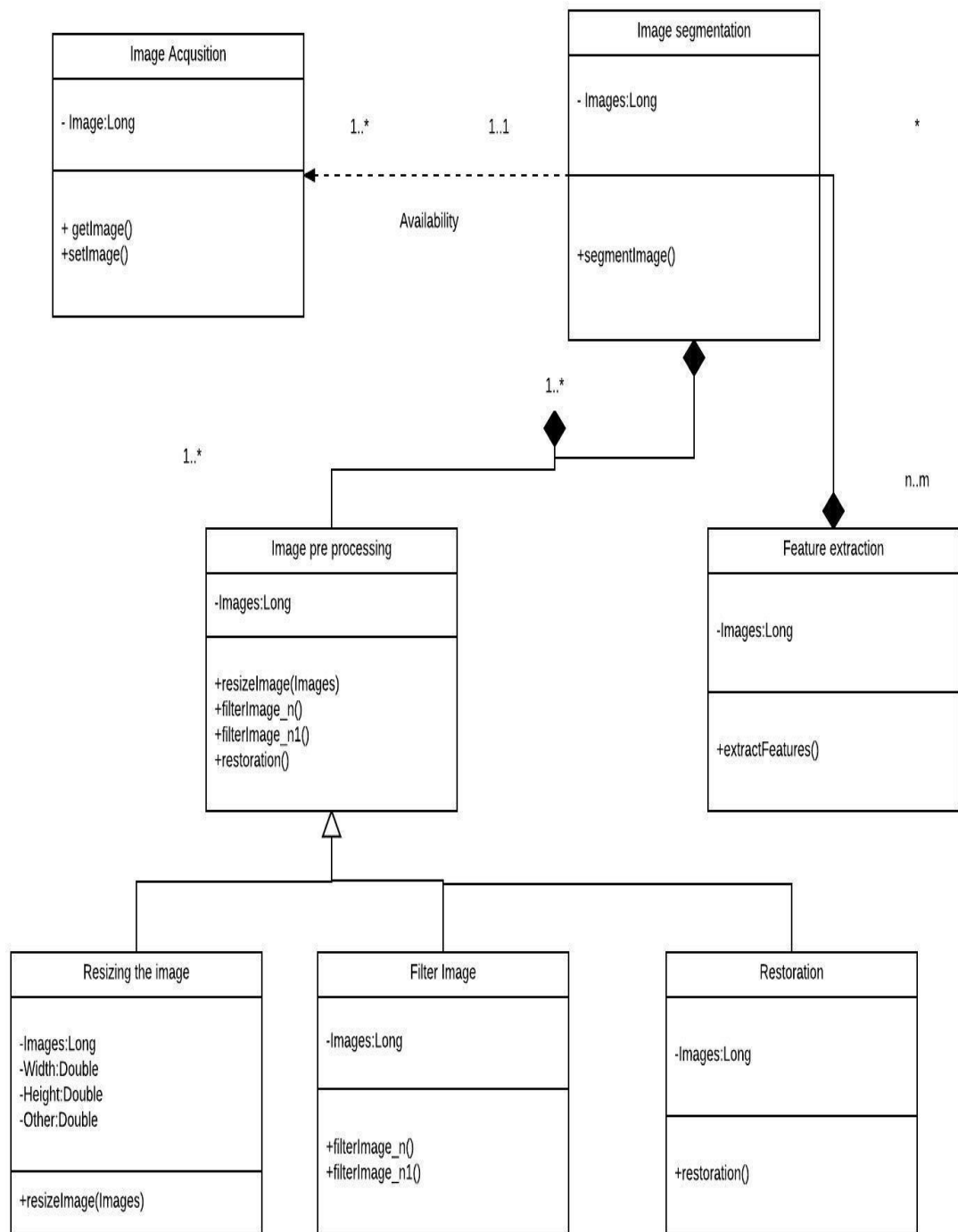


Figure 6 Class diagram for Images segmentation and feature extraction

3.3. Performance Requirements

3.4. Design constraints

The GUI s are developed attractively and in a user friendly way to attract users to the application at their first sight 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 effecting 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.

4. References

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