

FUNCTIONAL SPECIFICATION

Detect and identify disease in plants

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Contents

Abstract.....	2
Project Inspiration.....	3
Project Overview	4
Functional Requirements	5
Use Cases.....	7
Brief Use Cases.....	8
References	12

Abstract

The purpose of this functional specification document is to lay out all functional and non-functional requirements of the disease detection and identification application. The purpose of this project is to develop an application that can detect and identify disease in plants accurately and efficiently. The goal is to remove the subjectivity for the process that currently exists as plants are inspected visual by a person who make a subjective decision.

Project Inspiration

The scientists in EnviroCORE are researching innovative environmental technologies and biotechnologies with a view towards enhancing the economic and social development in an environmentally friendly manner (envirocore, 2018). Researchers within EnviroCORE based at Institute of Technology Carlow (ITC) currently carry out visual inspections on plant leaves and make subjective opinions on the health of the plant. This project will produce an application that will remove this subjectivity from the process. This application will achieve this through the use of computer vision and machine learning. It is estimated that 39 percent of worldwide crops are lost to disease and insects. The ability to accurately detect and identify disease on plants is key to helping reduce this figure (Sfiligoj, 2018).

Project Overview

The purpose of this project is to detect and identify disease present in plants and also identify the species of plant from a given image which will either be taken on the device or provided from the user's image gallery on the device. All analysis will be carried out in the mobile application of the project. This will be done through the use of computer vision. Edge detection and image segmentation will be used to identify the species of plant and the disease that might be present on the plant. The species and disease will be identified by comparing the analysis to a database of images that are confirmed to have disease present. If disease is found to be present the user will then be able to upload the analysis which will include the image, the detected disease, the GPS location of the image, the weather at the time and location the image was taken as well as any note the user deems to be relevant to the image. Providing the location and time of the detection will mean the progression of the disease can be tracked for further inspection by any user of the system. Providing weather data will help to determine if it is a factor in the disease and its progression. The desktop will provide users with the ability to view their previous analysis and allow them to track the progression of any disease's they detect. The administrator will be able to add and remove users as well as view any analysis entered in the database. For this project to be successful it needs to contain certain components:

1. The mobile android application must be easy to use.
2. The mobile application must be able to perform the analysis of the images.
3. There needs to be a library of confirmed diseased plants to use as a reference.
4. The user needs to be able to upload any analysis where disease was detected.
5. The administrator needs to be provided with an administrator page that will allow them to create new user accounts, inspect and manage all analysis entries into the database and generate reports based on certain aspects such as disease type or plant species.

Functional Requirements

Hardware

- Android Device
 - An Android device will be required to run the application.
- Camera
 - The Android device must have a camera in order to properly utilise the application.
- Desktop PC
 - A desktop PC will be required for users to access the database and view results of previously performed analysis. This will also be needed for the Administrator to create, edit or delete user accounts.

Software

- Java
 - The application will be written in Java, Java is the native language to android and is the predominant language used to write application for android devices. Java also has computer vision library called OpenCV.
- OpenCV
 - This application will use OpenCV, which is a computer vision library available for C++, Java, and Python. As the main function of this application is to process images it's highly important that the computer vision library is of a high standard.
- Python/Django
 - The Website will be written in Django which is a Python based web framework work, Django provides many useful features that will help when developing the backend of the system.
- Database
 - Two SQL database's will be used in this application the first will store the user credentials of the application which will consist of two columns username and password, and the second will store the results of analysis, this database will consist of eight columns consisting of image, plant species, whether diseases is detected or not, type of disease, weather information from when image was

captured, GPS information from when the image was captured, date from when the image was captured, and notes from the uploader about the analysis.

- Performance and reliability
 - The application will need to be able to process an image either taken by the device or from the user's image gallery it is very important that the image processing is carried out within a reasonable amount of time. As in all computer activities seconds can seem like a lifetime for a user, because of this it is important that the analysis takes no longer than 5 seconds. This is also an important factor considering the user will most likely be analysing several plants in a row and if analysis takes too long using the application can seem like a hindrance more than a help. The accuracy of the analysis is also highly important as one of the main purposes of this application is to remove the subjectivity from the analysis introduced by humans. This application will aim to achieve over 90% accuracy when identifying disease and percentage of disease detected on the plant.

Use Cases

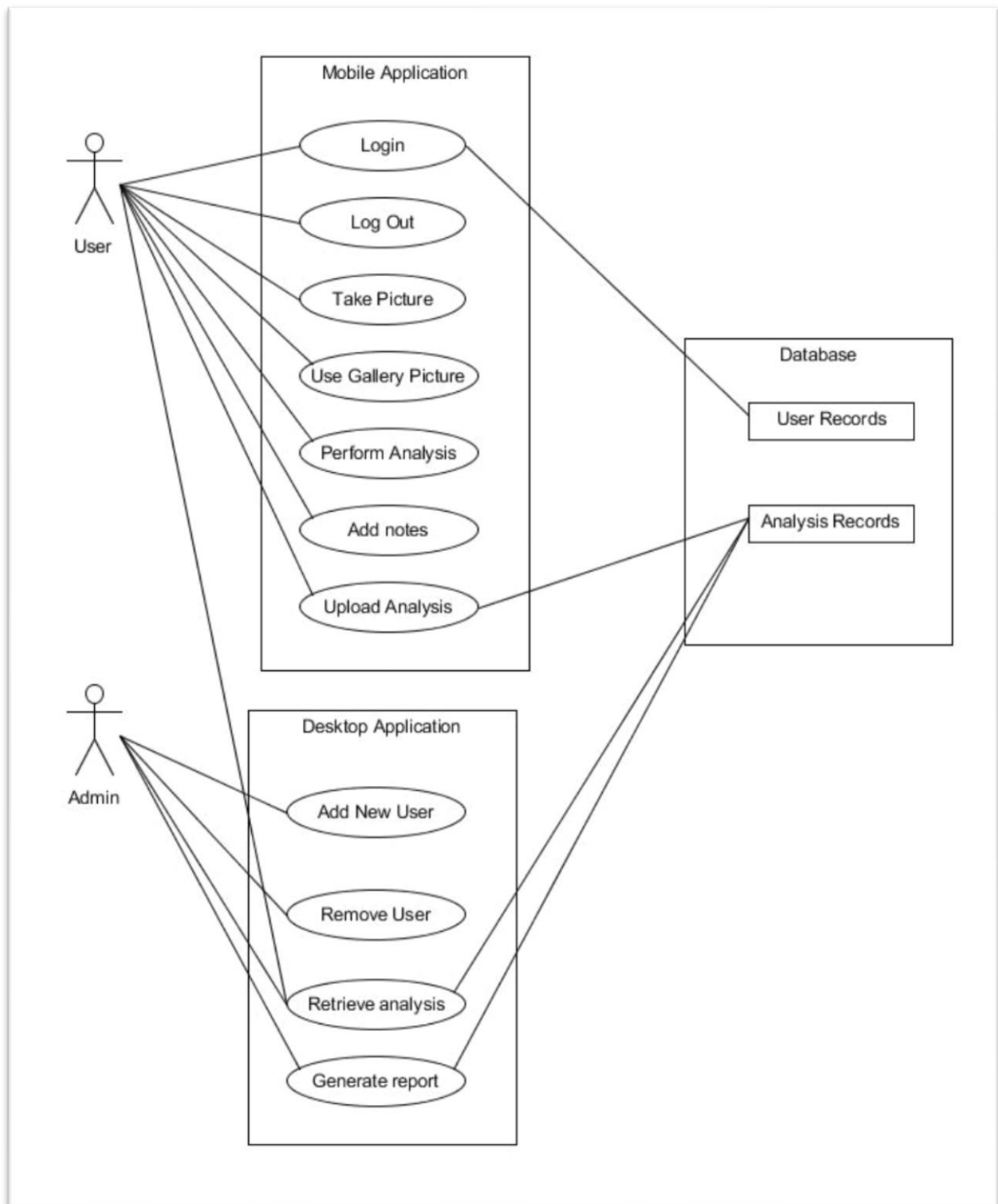


Figure 1.1 – Diagram of use cases.

Brief Use Cases

Name : Login	
Actors	User, mobile application, database.
Preconditions	User already has an account. The application has loaded and is displaying the login screen to the user.
Activity	This use case begins when the user has selected the login option when the application has loaded. The user enters their details i.e. username and password. The user's details are then compared with the database to verify the user.
Postcondition	The user is successfully logged in.

Name : Log Out	
Actors	User, mobile application, database.
Preconditions	The user is currently logged into the application.
Activity	This use case begins when a user has selected the logout option from the main screen of the application. The application logs out the user and kill the session.
Postcondition	The user is successfully logged out.

Name : Add New User	
Actors	Administrator, desktop application, database.
Preconditions	The Administrator is logged into the desktop application.
Activity	This use case begins when the administrator selects the add new user function. The application then asked the administrator for the user's credentials. When the user's credentials are entered the administrator then selects Add user, which creates a new user with the given credentials in the user database.
Postcondition	A new user is created and added to the database.

Name : Remove User

Actors	Administrator, desktop application, database.
Preconditions	The Administrator is logged into the desktop application.
Activity	This use case begins when the administrator selects to a remove user. The application then asked the administrator for the user's credentials. When the user's credentials are entered the administrator then selects remove user, which then searches the database for the user and removes then from the database.
Postcondition	A user is removes from the database and in turn the application

Name : Take Image

Actors	User, mobile application.
Preconditions	The user is currently logged into the application.
Activity	This use case begins when a user has selected to take a picture. The application then displays the camera to the user to take a picture. When the user takes the picture, it is displayed back to them while the application performs analysis on the image. The results of the analysis are then displayed to the user.
Postcondition	The user has successfully taken a picture.

Name : Use image from gallery

Actors	User, mobile application.
Preconditions	The user is currently logged into the application.
Activity	This use case begins when a user has selected to analysis an image from the gallery on the device. The application displays user's gallery to the user to select an image. When the user selects the image.
Postcondition	The user has successfully taken an image and performed analysis.

Name : Perform analysis

Actors	User, mobile application.
Preconditions	The user is currently logged into the application.
Activity	This use case begins when the user takes a picture or selected an image from their gallery. The picture is displayed back to them while the application performs analysis on the image. The results of the analysis are then displayed to the user.
Postcondition	The user has successfully performed analysis on image.

Name : Add notes to analysis

Actors	User, mobile application.
Preconditions	The user has performed analysis an image and selected add notes to analysis.
Activity	This use case begins when the user has selected to add note to the analysis. the application provides the user with a text box to enter notes, the user enters their notes and selects ok.
Postcondition	The user has successfully entered notes for an analysis.

Name : Upload analysis

Actors	User, mobile application, database.
Preconditions	The user has performed analysis, received results and enter notes on analysis.
Activity	This use case begins when a user selects upload. The application then creates a new entry in the disease database using the information obtained from analysis and the user notes.
Postcondition	The user successfully uploads the results of analysis to the database.

Name : Retrieve results of previous analysis

Actors	User, desktop application, database.
Preconditions	The user is currently logged into the desktop application.
Activity	This use case begins when a user has logged into the desktop application. The user then selects the to retrieve previous analysis. The user enters the credentials of which results they are looking for. The desktop application then retrieves any entries in the database that match the information given. The information about matching results are then displayed to the user.
Postcondition	The user successfully retrieves analysis information from the database

Name : Generate report

Actors	Admin, desktop application, database.
Preconditions	The admin is currently logged into the desktop application.
Activity	This use case begins when the admin wishes to generate a report based on previously stored analysis' in the database. The admin selects the analysis he wishes to generate reports for and selects generate report.
Postcondition	The admin successfully retrieves the generated report of analysis'

References

- envirocore. (2018). *envirocore.ie*. Retrieved from envirocore.ie: <http://www.envirocore.ie/>
- Sfiligoj, E. (2018, April 9). *The Disease/Insect Outlook for 2018: New Challenges at Every Turn*. Retrieved from croplife: www.croplife.com