Software Requirements Specification

For

Portable Soil Detection System based on Image Processing for Agriculture

Team Colon

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Table of Content

Contents

1. Introduction

1.1 Purpose of the document

The purpose of this document is to present a detailed description on the project “Portable Soil Detection System based on Image Processing for Agriculture”. It will illustrate the purpose and the features of the system, what the system will do, its requirements, the constraints under which it must operate and how the system will react to external factors.

This document will serve as a primary reference material for all the developers of this project, and also this can be used as the reference material for anyone who is interested in this project.

This document has presented a comprehensive explanation about the design of the project by including the use case diagrams, use case scenarios, ER Diagram and activity diagrams.

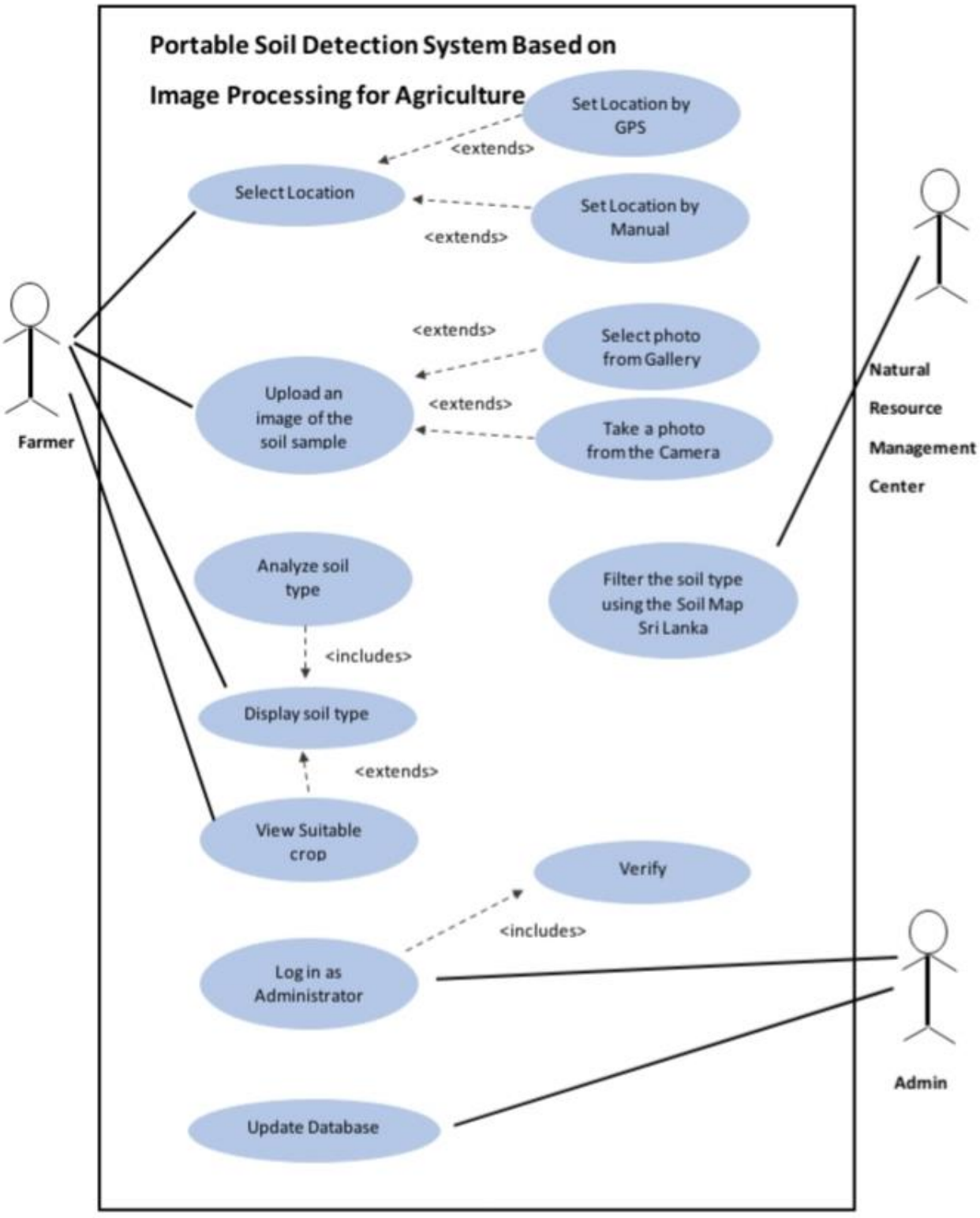
The implementation is explained further using functional and non-functional requirements of the project.

1.2 Project Introduction

This project is basically designed to suggest the best suitable crop for farmers based on the soil type of their lands. Farmers take photos of a soil sample of the land from his mobile phone and can upload them to our proposed mobile application and they quickly get the suggestions about the suitable crops for their lands. This system will help to increase the harvest and profit of the farmers and to reduce the unnecessary expenditure occurring due to wrong crop selection.

2. Project Scope

2.1 Use case Diagram



2.2 Brief description about the actors and use cases

There are three actors in the use case diagram namely, farmer who utilizes the benefits of the system, the admin who is involved with updating the system and the Natural Resources Management Center from which the soil map of Sri Lanka is obtained.

The first use case which involves with the user is opening the application from his mobile phone. For this he must have downloaded the application first. According to the next use case involving in the farmer, he has to either upload his location in the map that we have included to the application or select the option to automatically detect his location by the system. The next use case describes that the user should upload a photo of the soil sample to the system either by selecting from the gallery or taking a photo through the application.

Here the system involves with another actor, Natural Resources Management Center from which the system obtains the soil map of Sri Lanka to filter the soil type based on the location of the farmer.

The soil type will be then suggested to the user and the user can view the suggested crops to that soil type as per the preference of the farmer.

The use cases involving the admin is updating the database and log in, where the admin is able to update the crops and soil types as per his wish.

2.3 Use case Scenarios

Use Case Name	Select Location
Use case no	1
Actors	Farmer
Pre- Conditions	Farmer has launched the app
Description	1. An interface with two selection options to select the location is display to the farmer from which the farmer selects the location. 1.A.1: Set location by GPS 1.A.2: Set location by farmer. Framer select the location by Province Farmer select the location by District Farmer select the location by Grama Niladhari Division 2.Farmer select next option 1.A.3: Farmer closes the app 3.Direct to the upload

Post- Condition	The location of the farmer has been saved.
Business rules	

Use case name	Upload an image of the soil sample
Use case no	2
Actors	Farmer
Pre- Conditions	Farmer has input the location & taken the photo
Description	1.An interface with two selection options to upload an image of soil sample is display to the farmer, from which he select one option. 2.A.1: Farmer uploads photo from the gallery 2.A.2: Farmer takes a photo from the camera 2.User uploads the photo 2.E.1: User uploads a low resolution photo 2.E.2 User uploads an unrelated photo
Post-condition	A confirmation message is displaying to the user.
Business rules	Photo should be of a minimum size of 5MB.

Use Case Name	Filter soil type using the soil map of Sri Lanka
Use Case ID	3
Actor	Natural Resources Management Centre
Pre- Condition	Farmer upload the photo. Location is selected.
Description	1. System refers the soil map of Sri Lanka obtained from the Natural Resources Management Centre and filters the soil types according to the location set by the user.

	2. Direct to analyze soil process. 1.Analyze by porosity. 3.E.1.can't analyze porosity from the uploaded photo. 2.Analyze by grain size. 3.E.2.Can't analyze grain size from the uploaded photo. 3.Analyze by moisture level. 3.E.3.Can't analyze moisture level from the uploaded photo. 4.Analyze by color. 3.E.4.can't analyze color from the uploaded photo.
Post –Condition	Analyzed result is directed to the display soil
Business rules	

Use case Name	Display the soil type
Use case ID	4
Actors	Farmer
Pre-condition	Photo should be uploaded and analyzed.
Description	1.Using analyzed data the system displays the soil type corresponded to the photograph uploaded. 1.A.3: Farmer closes the application. 4.E.1: Soil type is not detected. 4.E.2: Database connection failure.
Post condition	Soil type is displayed

Use case Name	View suitable crop
Use case ID	5
Actors	Farmer
Pre-condition	Soil type should be detected.

Description	1.According to the soil type, system displays the best crop to be cultivated in that soil type. 1. A.1: User closes the application. 4.E.2: Database connection failure.
Post condition	Display the best crops.

Use case Name	Login as Administrator
Use case ID	6
Actors	Admin
Pre-condition	System Displays the admin login option.
Description	1. Admin enters the admin name. 2. Admin enters the password. 6A.1: Admin forgot password. 6.A.1.E.1: Didn't get verify code 3. Admin selects submit option. 6.A.2: Admin selects cancel option. 4. Admin name and password validate. 5. Display the main window. 6.E.2: Admin name or password is incorrect.
Post condition	Successfully logged into the main window.
Business Rules	Admin should have included admin's details to the system.

Use Case Name	Update Database
Use Case No	7
Actors	Admin
Pre- Conditions	The user must be an authorized admin.

Description	1. Update the soil table with a different type of soil or the crops table with a new type of crops 7.A.1: The admin decides to not to update the crops or soil types. 7.E.2: Unsuccessful update 2. Get notification about the successful update 3. Direct to the main admin panel
Post-condition	A message is sent to the admin to confirm the update
Business rules	System should not allow the updating facility for an unauthorized administrator

2.3.1Exceptions and alternate scenarios

1.A.1: Set location by GPS.	
Actors	Farmer
Pre-condition	Farmer has selected select location and set location by GPS option
Description	Farmer selects the option to automatically detect his location using GPS in his phone. The system then redirects to the GPS facility of the phone.
Post condition	Direct to upload an image of the soil sample interface.

1.A.2: Set location by farmer.	
Actors	Farmer
Pre-condition	Farmer has selected select location and set location by farmer option
Description	Farmer sets his location manually by selecting the following options from a drop down menu bar. 1. select the location by Province 2. select the location by District 3. select the location by Grama Niladhari Division
Post condition	Direct to upload an image of the soil sample interface.

1.A.3:User closes the app	
Actors	Farmer
Pre-condition	User has launched the app
Description	1. Select the exit option 2. Confirm the exit
Post Condition	Direct to the home screen of the user

2.A.1. User take the photo from gallery.	
Actors	Farmer
Pre- Condition	Farmer has selected upload an image of the soil sample option and select photo from gallery option.
Description	Farmer selects take a photo from gallery option, and the application will open the gallery. Farmer has to upload the image of the soil sample.
Post –Condition	Pre-captured image will be uploaded as the photograph of the soil sample.

2.A.2: Farmer takes a photo from the camera	
Actors	Farmer
Pre-condition	Farmer has selected upload an image of the soil sample option and take photo from camera option.
Description	Farmer selects take a photo from camera option, and the application will open the mobile device camera. Farmer has to capture the image of the soil sample.
Post-condition	Captured image will be uploaded as the photograph of the soil sample.

2.E.1: User uploads a low resolution photo	
Actors	Farmer
Pre-condition	Farmer uploads the photo
Description	Uploaded image resolutions are low than required, system cannot detect the image clearly
Post Condition	Display ‘please upload good quality photo’

2.E.2: User uploads an unrelated photo	
Actors	Farmer
Pre-condition	Farmer uploads the photo
Description	Uploaded image doesn’t relate with the required parameters of soil analyzing.
Post Condition	Display please upload related photo

3.E.1:can’t analyze porosity.	
Actors	
Pre-condition	Farmer has uploaded a related image and the map has been referred.
Description	System can’t be analyze porosity. 1. Difficult to identify the porosity of the soil using the photograph. 2. System/ Database hasn’t updated for that soil type. 3. The entered data may be incorrect. 4. Send the error report message to admin
Post Condition	System can’t get the result using the porosity parameter. Admin is notified.

3.E.2: can’t analyze grain size.	
Actors	
Pre-condition	Farmer has uploaded a related image and the map has been referred.

Description	System can’t be analyze grain size. 1. Difficult to identify the grain size of the soil using the photograph. 2. System/ Database haven’t update for these soil type. 3. The entered data may be incorrect. 4. Send the error report message to admin
Post Condition	System can’t get the result using the grain size parameter. Admin is notified

3.E.3:can’t analyze moisture level.	
Actors	
Pre-condition	Farmer has uploaded a related image and the map has been referred
Description	System can’t be analyzing moisture level. 1. Difficult to identify the moisture level of the soil using the photograph. 2. System/ Database haven’t update for these soil type. 3. The entered data may be incorrect. 4. Send the error report message to admin.
Post Condition	System can’t get the result using the moisture parameter. Admin is notified.

3.E.4: can’t analyze color.	
Actors	
Pre-condition	Farmer has uploaded a related image and the map has been referred.
Description	System can’t be analyze color. 1. Difficult to identify color of the soil using the photograph. 2. System/ Database haven’t update for these soil type. 3. The entered data may be incorrect. 4. Send the error report message to admin.
Post Condition	System can’t get the result using the color parameter. Admin is notified.

4.E.1: Soil type is not detected.	
Actors	
Pre-condition	System has analyze the uploaded photograph of the soil sample

Description	System cannot detect the soil type using the provided data in the system database.
Post-condition	Soil type is not displayed on the screen and alert user.

4.E.2: Database connection failure.	
Actors	
Pre-condition	System has analyze the uploaded photograph of the soil sample.
Description	To display the soil type for the user, system checks the similar soil types under the parameters in the database. When the connection to the database is lost, the system cannot display the soil type.
Post-condition	Soil type is not displayed on the screen and alert user.

6.A.1: User forgot password.	
Actors	Admin
Pre-condition	Display error message as password is incorrect. User doesn't remember password.
Description	1. Admin clicks on Forgot password. 2. Display area to type Admin's e-mail address. 3. Admin types e-mail address 4. Admin selects submit. 5. System sends a message with verify code to admin's e-mail address. 6. Display area to type verify code. 7. System validate verify code. 8. Display area to change password. 9. Admin enters admin name and password. 10. Admin reenters the new password. 11. Admin selects submit option.
Post condition	Successfully changed password.

6.A.1.E.1: Didn’t get verify code	
Actors	Admin
Pre-condition	Admin should enter the e-mail address and sent the verification code.
Description	System has a connection error or entered e-mail address is invalid.
Post condition	Admin didn’t get a verification code.

6.E.2: Admin name or password is incorrect.	
Actors	Admin
Pre-condition	Display error message.
Description	Admin entered an incorrect password or incorrect admin name.
Post condition	Admin cannot access to the system.

6.A.2: Admin selects cancel option.	
Actors	Admin
Pre-condition	Display required details to fill.
Description	Clear all filled details.
Post condition	New data can be entered.

7.A.1: Admin is not a registered Administrator	
Actors	Admin
Pre-condition	Admin has clicked the login button.
Description	In order to update the soil types and crops the admins should be a registered administrator

Post-condition	Display error message stating that the admin is not a registered administrator

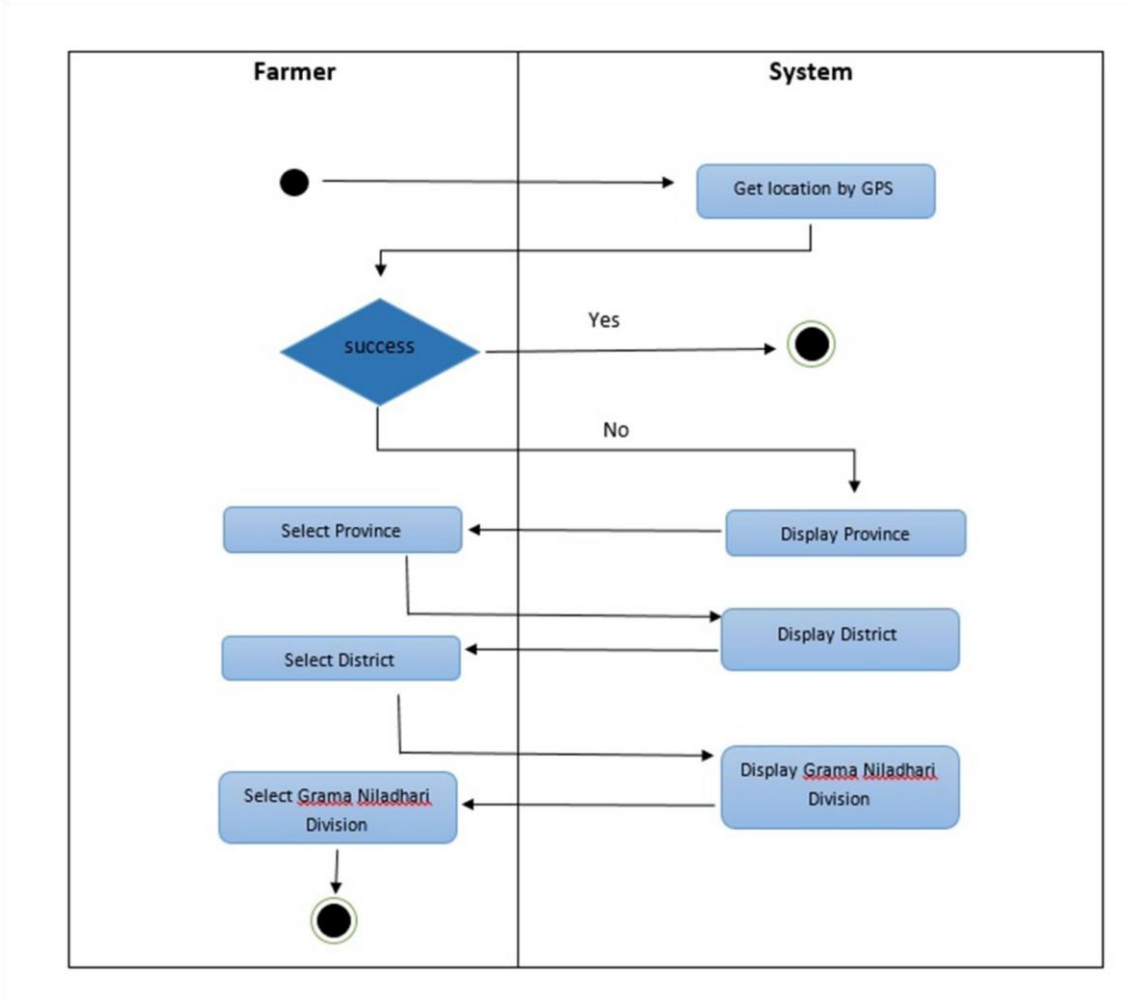
7.A.2: The admin decides to not to update the crops or soil types.	
Actors	Admin
Pre-condition	Admin has clicked the update button
Description	After clicking the update button user changes his mind not to
Post-condition	Display a confirmation message to the admin stating whether he is sure to apply the updates. The admin can select “no” if he changes their mind.

7.E.1: unsuccessful login	
Actors	Admin
Pre-condition	Admin has clicked the login button.
Description	Admin has entered incorrect admin name or password.
Post-condition	Display error message “un successful login”.

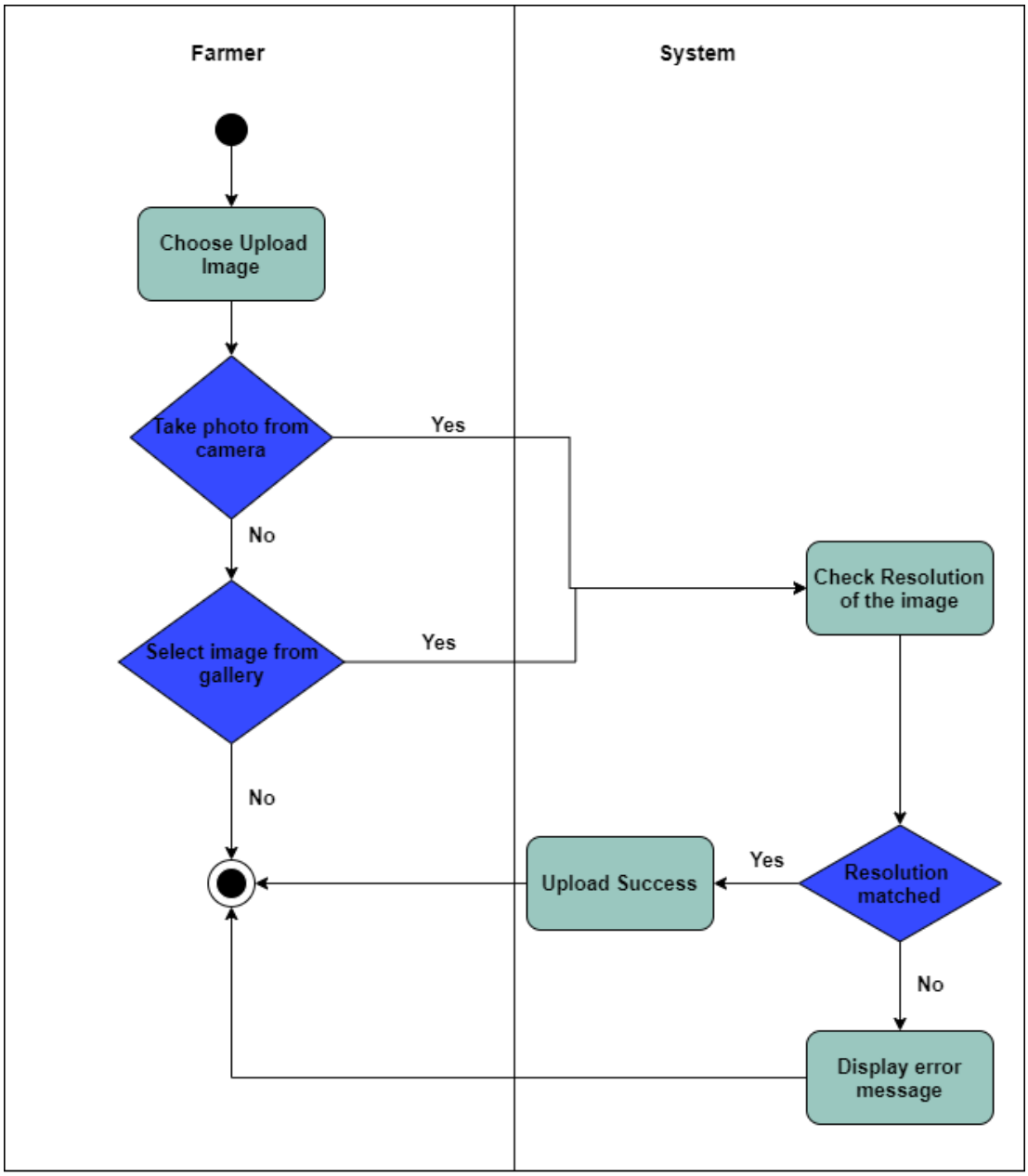
7.E.2: Unsuccessful update	
Actors	Admin
Pre-condition	Admin has clicked the update button.
Description	1. Number of characters enter has exceeded the maximum define limit. 2. The data type of the input as a mismatch with the defined data type.
Post-condition	Display error message “un successful update”.

2.4 Activity Diagram

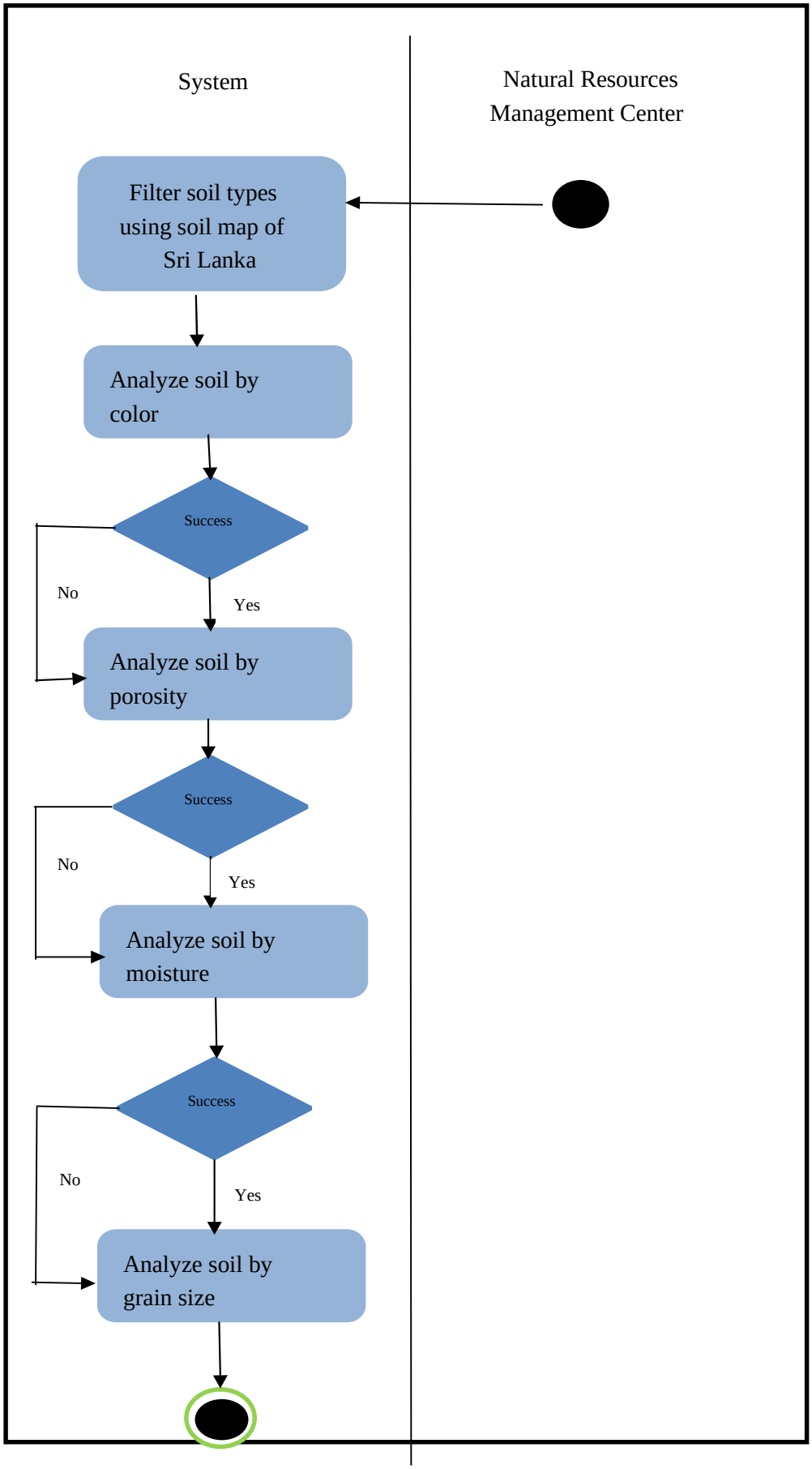
Select location



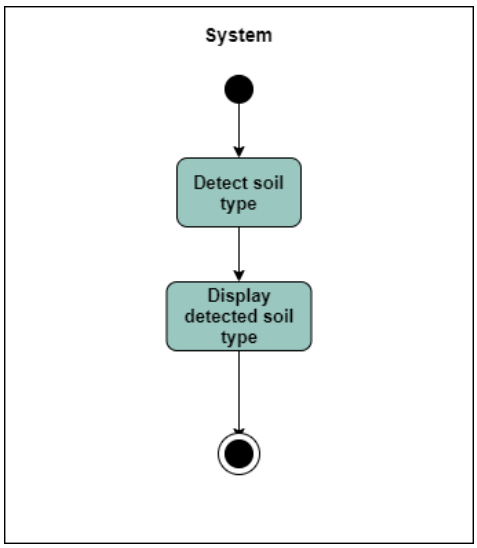
Upload an Image of the soil sample



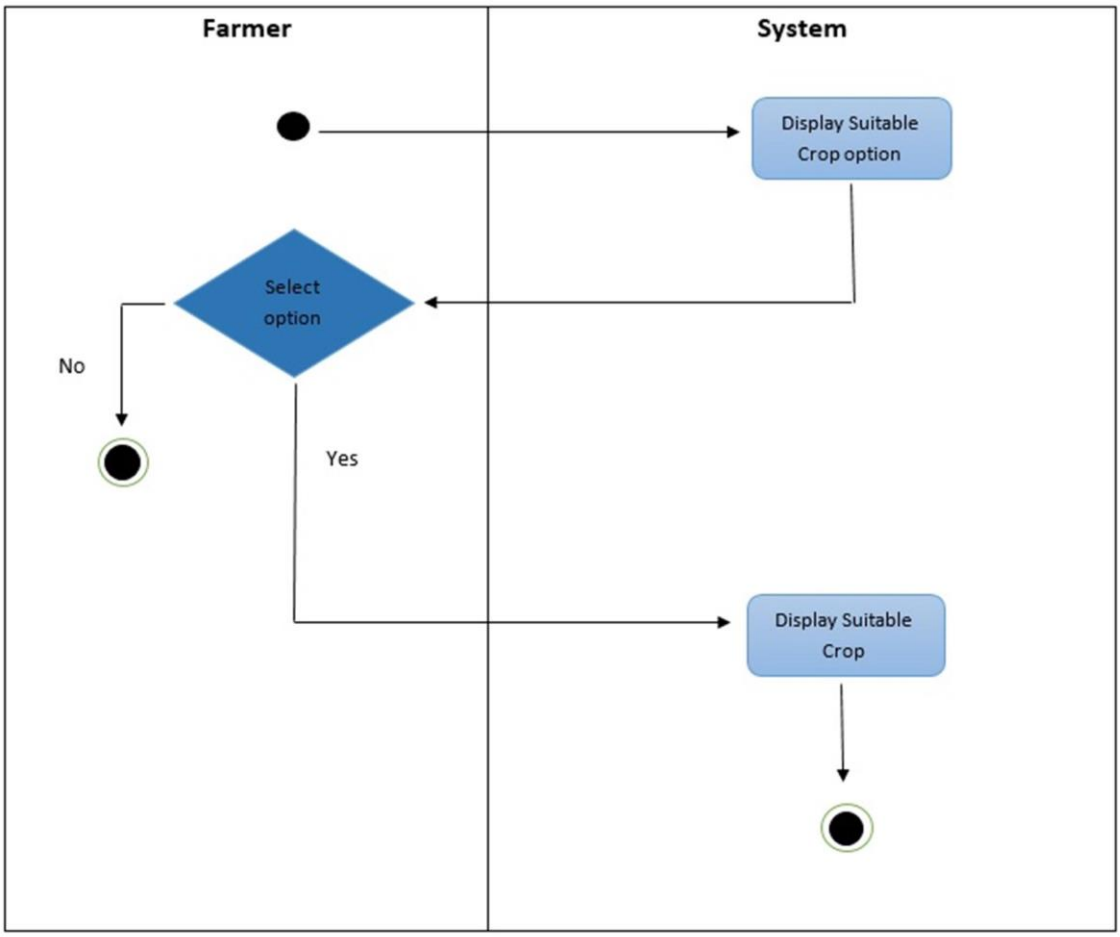
Filter soil type using the soil map of Sri Lanka



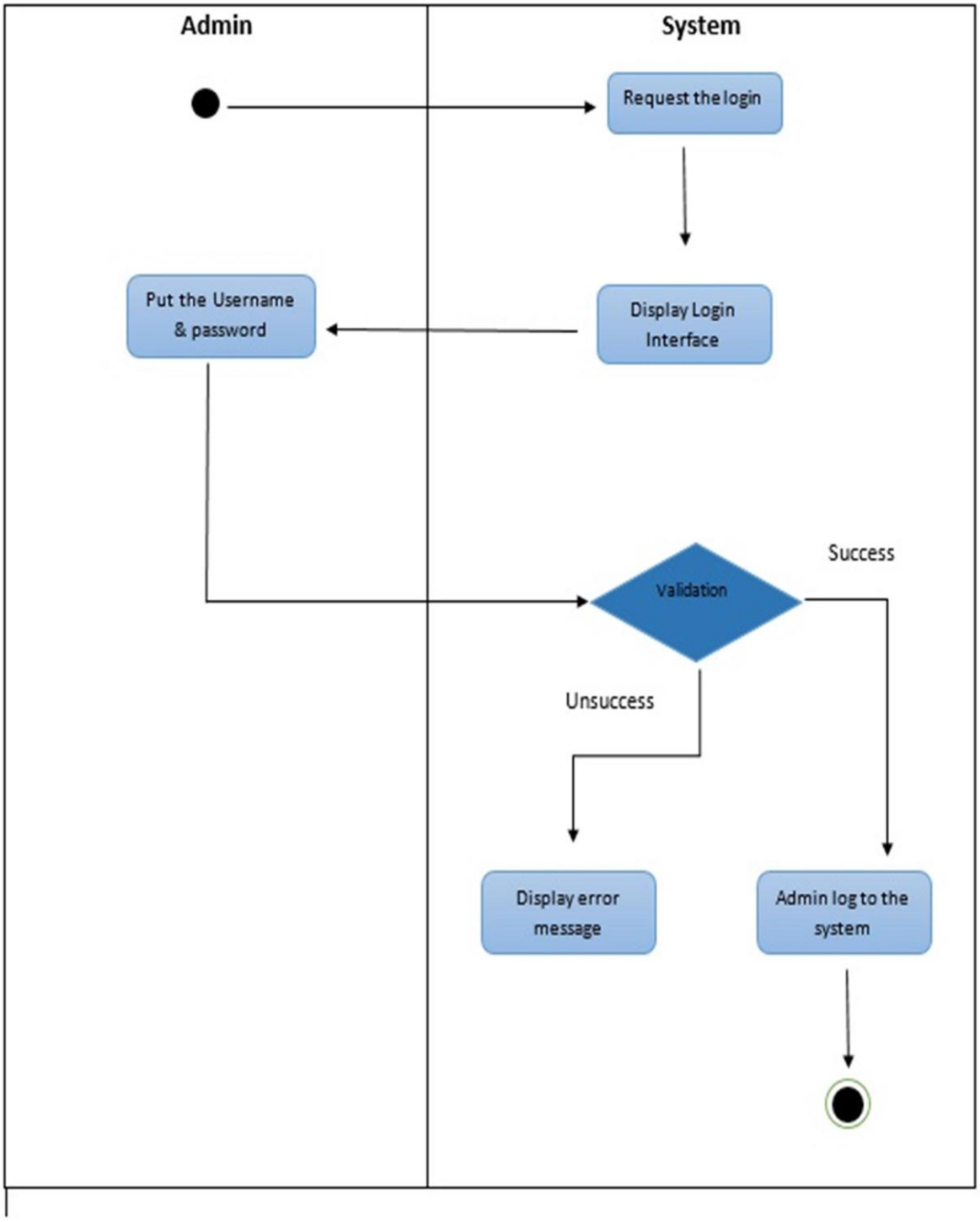
Display Soil Type



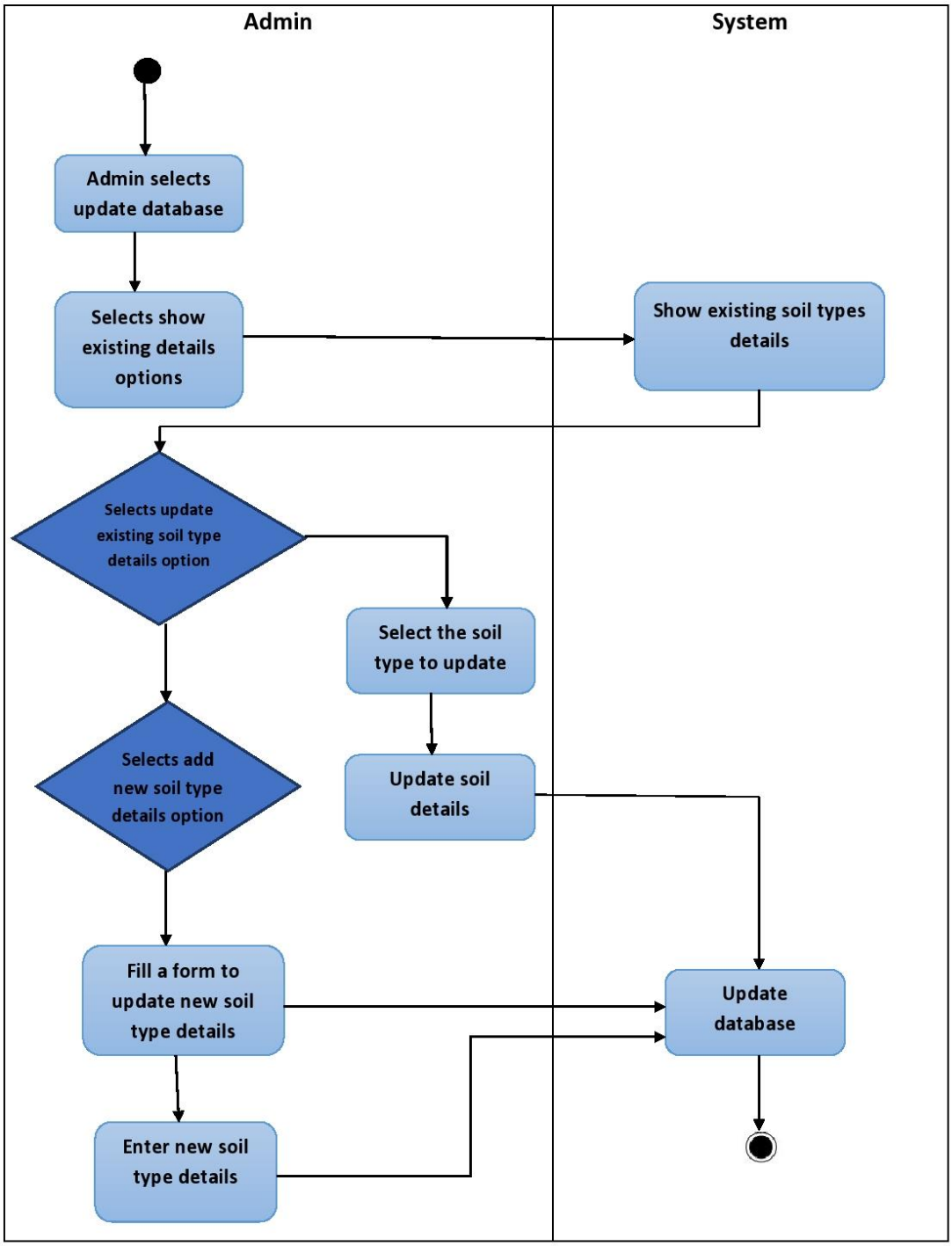
View suitable crop



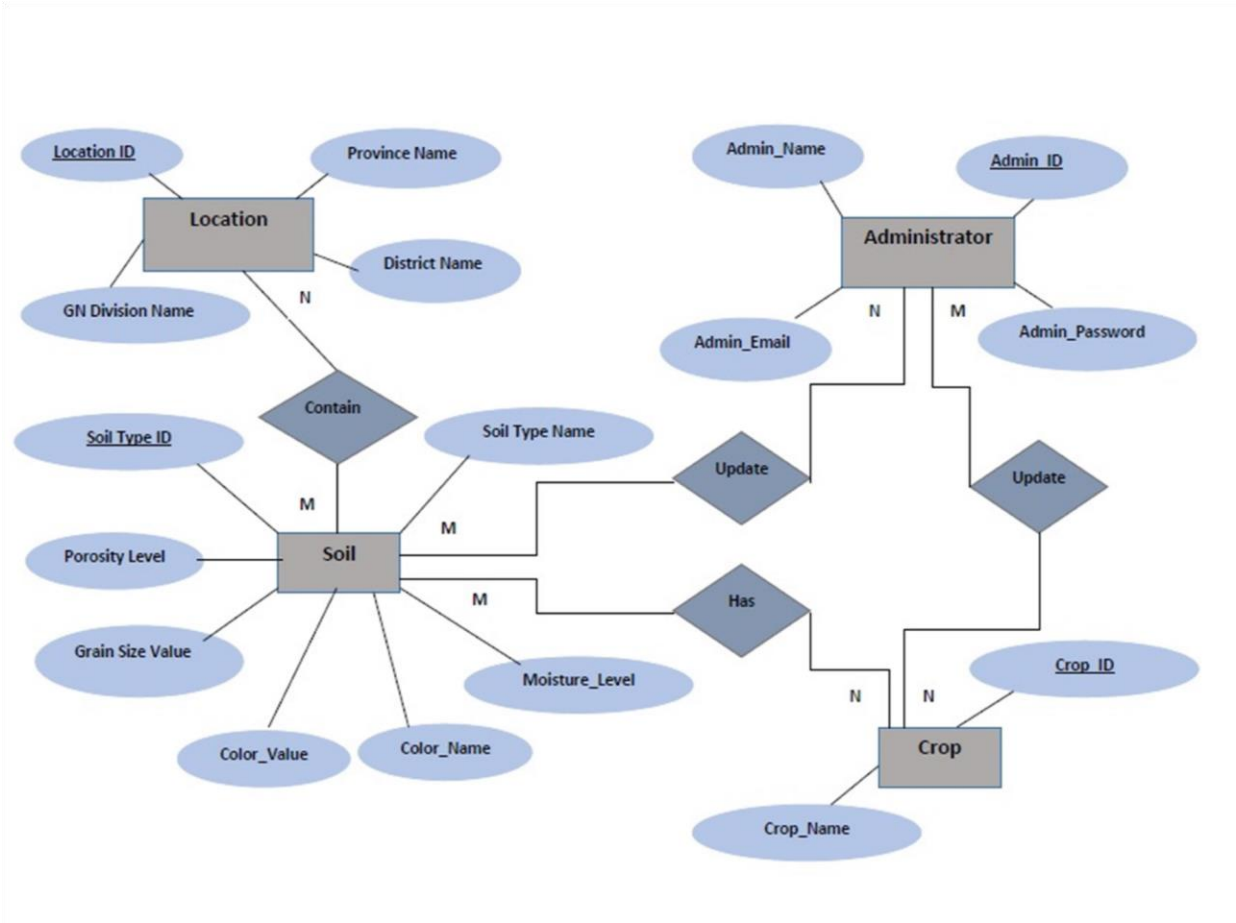
Login as administrator



Update database



3. Entity Relationship Diagram



4. Functional requirements

Priority Number	01
Function Name	Set Location
Description	This function is responsible for the user to select his exact location.
Input	User Inputs about location details
Process	1.System first displays the available Provinces 2.User inputs the relevant province. 3.System first displays the available District 4.User inputs the relevant District. 5.System first displays the available Grama Niladhari Division. 6.User inputs the relevant Grama Niladhari Division. 7.User confirms his inputs.
Output	User is directed to the ‘upload photo’ page

Priority number	02
Function name	Upload image of the soil sample and refer the soil map
Description	Take or find photo of soil
Input	Photo and location from user.
Process	System get the photo input by user System check the photo suitable for refer If it is suitable system redirect to the next step, it isn't system display "please upload relevant photo" System refer the soil map in database and compare image with database.
Output	User is directed to the display soil type page

Priority Number	03
Function Name	Analyze soil by porosity
Description	This is one out of the four ways used to detect the soil type. Soil type is detected by using porosity as a parameter.
Input	The image of the soil sample which was uploaded by the user.
Process	Here, Paraffin, containing a fluorescent dye is impregnated to the soil sample. Images are then acquired and digitized. Area and the perimeter of the pores are measured using image processing
	techniques
Output	Detected soil type based on porosity.

Priority Number	04
Function Name	Analyze the soil sample by moisture level

Description	This function will analyze the soil type by the moisture level according to the data in the database and produce results.
Input	The image of the soil sample which was uploaded by the user.
Process	Admin has provided the images of different moisture level of different soil type by using following method. • Take the soil sample and oven-dry that, to remove the moisture it contains already, and take a photograph of that soil sample. It is the color of the soil type in 0 moisture level. • After that add 10ml of water to the above soil sample and take a photograph of the soil sample. It is the color of that soil type in that moisture level. • Again add another 10ml of water (now- 20ml) and take a photograph. • Repeat the above process until the soil type gets to its maximum saturation level. And store the images of respective moisture levels. System is analyzing the image of the soil sample which was uploaded by the user and compare it with images in the database. And it will detect the soil moisture level and the soil type. .
Output	Produce results of detecting the soil type by moisture level.

Priority Number	05
Function Name	Analyze the photograph by grain size.
Description	This function can be used to analyze the photograph by grain size and get the parameters to detect soil.
Input	The photograph of previous uploaded.
Process	The grain size of the soil sample is determined by initially applying image enhancement techniques on the uploaded image. Then the grain size is calculated by using edge detection techniques.
Output	Produce results of detecting the soil type by grain size.

Priority Number	06
Function Name	Analyze soil by color
Description	This is one out of the four ways used to detect the soil type. Soil type is detected by using surface color as a parameter.
Input	The image of the soil sample which was uploaded by the user.
Process	Detect soil type by color using image processing techniques
Output	Detected soil type based on surface color.

Priority Number	07
Function Name	Display soil type.
Description	This function can be used to display the soil type.
Input	The details of analyzed results.
Process	Displays the necessary things. (detect or in detect soil type) Displays the soil type.
Output	Display what kind of soil type.

Priority Number	08
Function Name	Display the suitable crops
Description	Display the best suitable crops according to the soil type.
Input	Detected soil type.
Process	Extract data from database and display the list of best suitable crops to be cultivated in that soil type.
Output	Suitable crops are displayed on the screen.

Priority Number	09
Function Name	Update the database
Description	Using this function, the administrator can update the database with new types of soil and crops
Input	• New details of soil • New type of crop
Process	The system will update the Soil table and Crop table in the database by inserting the new type of crop or soil
Output	Updated Database

Priority Number	10
Function Name	Closing the application
Description	Using this function, the user can close the application and redirect to the home screen
Input	
Process	The system will close the application and redirect to the home screen of the user's phone
Output	Home screen of the user's phone

5. Non-functional requirements

Non-functional requirements deal with the behavior of a system or the technical aspects. On the surface these may not seem important to the business user or customer who have a greater interest in the functional requirements. Non-functional requirements define system properties and constrains, such as Performance, Maintainability, Robustness, Efficiency, Availability and reliability. Therefore, following Non-functional requirements are identified.

Efficiency

- Efficient resource handling part is done by the proposed system, and it controls resources such as memory and processing time, and can be able to utilize all of necessary resources.
- Efficiency is increased by reducing the processing time to less than 3 seconds.

Reliability

- All modules perform tasks approximately to 95% of accuracy, and without any interruption.
- Keeping database backups will enhance the reliability.

Usability

- Software has a simple, appropriate user interface and adequate documentation.
- The colors were chosen sensibly as the farmer is using the app outdoors which in turns will enhance the usability.
- This system will provide online help facilities, user interfaces, navigation links, contact details of management staff and documentation to enhance user friendliness.
- The usability of the system could also be enhanced by providing a complete and simple user manual to the user of the system.

Maintainability

- Software is to be written in the better way, that it may be evolved to meet the future changing of customers.
- By providing system code with proper comments, use of good programming style, program code representing with proper indentation, etc. are used for improve maintainability.
- Downtime has been reduced to a value of 3.3hrs. to further improve the maintainability.

Availability

- As a mobile application is used the system can be able to access 365×7×24 hours from anywhere.

Performance

- Response and processing time of the system have been enhanced using Query optimization of SQL commands.
- App launching time has been reduced to 2 seconds to increase the performance.
- Photo upload time has been reduced to 10 seconds

Security

- Database could only be updated by the authorized administrator hence enhancing the security of the system.
- The location of the farmer will only be used for the system purposes and will not be exposed to the outside.

Signatures of team members

Name	Registration Number	Index Number	Signature
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W.M.D.H. Bandara	ICT/2016/2017/008	3884	
J.P.R. Thakshila	ICT/2016/2017/064	3929	
T.L.U. Sudarshana	ICT/2016/2017/086	3948	

Date: 13/12/2020

Recommendation of the supervisors

Name: Mr. N.M.A.P.B. Nilwakke

Department: Department of Computing

Signature: ……  ……..

Name: Ms. Malithi Jayasooriya

Department: Department of Computing

Signature: ……..