A SYNCHRONIZED MOBILE AND WEB INFORMATION SYSTEM FOR CROP DISEASES

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By

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ABSTRACT

Zimbabwe as an agro economic country focuses immensely on the profit from farming. The government has been investing heavily on the inputs that help make farming easy. The major reason for developing such a system is to impact expert information to farmers at a click of a button.. This document consists of the development of a software system that gives farmers expert information. This system is an easy to use intelligent system that captures the crop disease and give information about that crop and treatment recommendations of that crop. The system development went through phases where there was an introductory phase. This phase consists a background of past information defining a problem that rose for the system to be justified on development. There is aspersion of objectives and the aim of the project. Thereafter, a feasibility study which looks deeply in the question, "can this be done?" There is a deep investigation on the technical, social and financial reasons that determines the development of this software a go. After a feasibility study, an analysis is done, verifying the benefit and constraints that were and are there that justifies why there is need to develop a new system. It flags out the shortcomings of the existing system and poses the cheapest way to meet requirement. Thereafter, the actual logical design of the system is done, inputting the unified modelling language diagrams that gives a conceptual feel of the system. The system is then actually done in the implementation phase and results are made. The system then goes through a lot of testing, among them are system testing, defect testing etc. A deployment strategy is emanated that will ensure acceptance as well as full exploitation of the system. This is where there is verification of which changeover strategy should be implemented. For the product to be of a consistent flair, it needs to be monitored and evaluated. Maintenance, monitoring and evaluation of the system is also done flagging the preventative methods and reactive methods. From there, recommendations are passed to the users on how to ensure an optimised use of the system. The farmers were recommended to update their database since new information will continually be added. The researchers were urged to train the bot for better precision. The administrators were recommended to allow further developments and maintain the system. All stakeholders were recommended to have first read the user manual to familiarize themselves with the system.

DECLARATION

I, **Chikara Hazel T,** hereby declare that I am the sole author of this dissertation. I authorise the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: ……………………………………….   Date: …………………………………..

APPROVAL

This dissertation, entitled **"A synchronised mobile and web information system crop diseases"** by **Chikara Hazel T** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University,** and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature: …………………………………………….

Date: ……………………………………………………………..

ACKNOWLEDGEMENTS

DEDICATION

This work is dedicated to my friends, family, Itai and Takudzwa for their abundant time they help facilitate this project into life. Another special dedication is extended to The Division of Research and Specialists Services for their acceptance for me to develop a system for their organisation.

Contents

LIST OF ACRONYMS

ARR   -Accounting Rate of Return

DR&SS   - Division of Research and Specialists Services

GDP   - Gross domestic product

GIS   - Geographic information system

IDE   -Integrated development environment

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CHAPTER ONE: INTRODUCTION PHASE

1.1 Introduction

A synchronised mobile and web information system crop disease bot is a system that allows the users to take the imagery form of a crop disease, thereafter search through its database to retrieve information about the disease. This information will include, the disease name, what it affects and ways to get rid of the pest or the disease which will be encompassed by the mobile platform of the system which will also locate nearest veterinaries. In this chapter, there will be a deep analysis of the background of the organization the definition of the problem at hand. Moreover, there will be a layout of the objectives that are to be achieved as well as the methods to achieve the objectives. Thereafter, a justification as to why the project was pursued.

1.1.1 Background Information

The Division of Research and Specialists Services (DR&SS) started being conventional in the year 1948. It has evolved from the stint of its development sustaining its chief directive and business utilities. The transformation has seen it being consolidated into the following three divisions:

1. The Department of produce enquiry which has six institutes and staff that are over 1062 who aid in this department

2. The Dissection of Livestock and Meadowlands Exploration which has four establishments and 627 staff that compliments this

3. The Division of Research Services, this department has 7 establishments and up to 674 total staff.

The Division of Research and Specialists Services is directed by a Prime Executive, it has three Dissections which are regulated by Chief Departmental Executives. Exploration being a paramount vehicle which helps enhancing the efficiency of agricultural productivity, fabrication and agricultural increase it is the main focus of the organization. Research-based evidence, products and technologies are beleaguered at advancing agricultural performance under various

physical and resource platforms. In contrast, agricultural monitoring services help protect the nation-state's food production by preventing the restrained introduction into the country of vexations and infections of confinement significance, to add on to assuring the nation of quality inputs of agriculture which are available on the market (dr&ss.inc, 2017)

1.2.2 Organisational structure

An organogram is a diagrammatical representation of the communication channel of an organization. They are three types of representations which are mostly implemented by organisations which are hierarchical, matrix and horizontal. Hierarchical organogram is where the subordinates are grouped clearly to one supervisor basing on function or geography or products. Matrix is in grid format/matrix where pooling of the same skill is done to different assignments. Horizontal is a setup which is implemented by small to medium companies where all the middle managers are removed leaving only the senior management followed by employees. In this research, hierarchical was used to define the company's organizational structure (Ghuman, 2010)
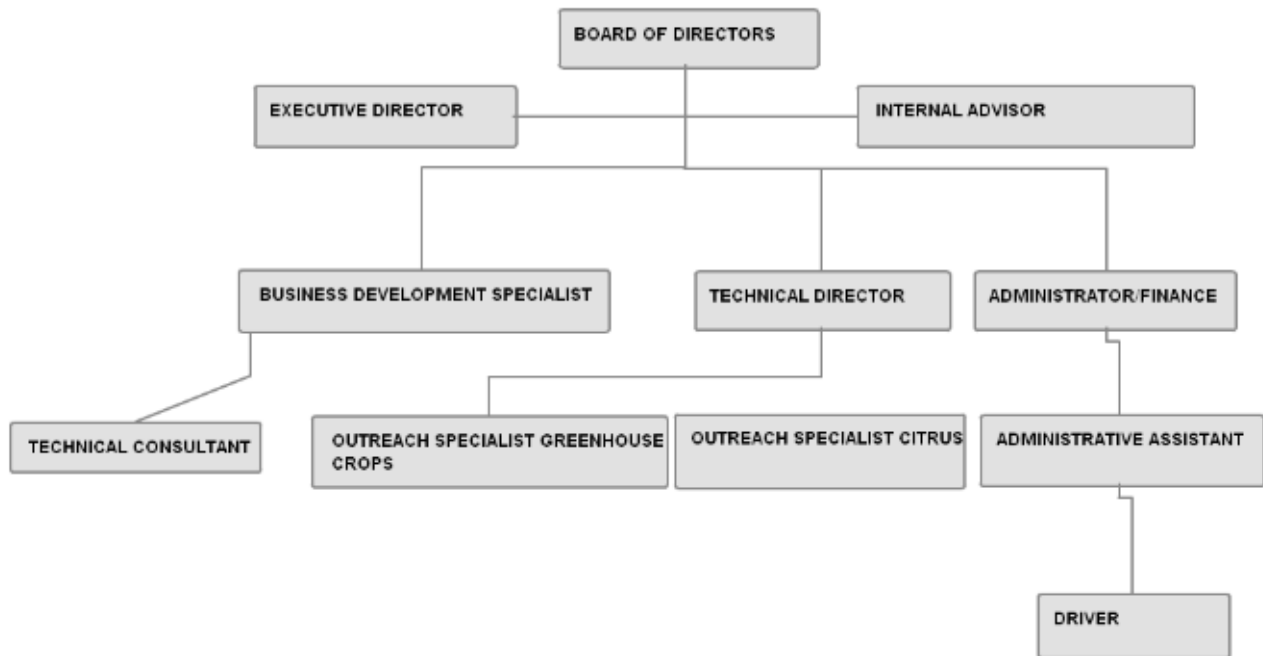
Figure 1.1 Organisational structure

1.2.3 Vision

According to Russo (2010), a company vision are the set of strategic objectives that the company has, road mapping where the company appreciates to be in the foreseeable future. They define the growth spurt of the company and instantiate its transformation initiatives. The department of Research and Specialists Services is envisioned towards being included amongst all chief agricultural study and other services establishments that are in the world by the year 2020 (dr&ss.inc).

1.2.4 Mission

A mission statement is a sentence that best describes the reason why the company was brought to life, it describes its function, markets and competitive advantages which may be summed up as the business goals and philosophies. It responds to the reason for the company's existence and its primary services (Hill & Jones, 2011). The department of Research and Specialists Services has a Mission Statement that is to provide research-based expertise, knowledge, information and technologies that aids in the development of a promising and supportable agrarian subdivision (dr&ss.inc,2017).

1.3 Problem definition

For the design, augmentation and implementation of a substantial system, problems were defined thus a solution was ascertained accordingly. The problems which were encountered were limitations that hindered working productively. Farmers had to consult the research department and hire consultants to advise them, which translated to immense expenses as well time which they took going back and forth to the department for approval of surveys. To counter this, farmers had resorted to rely on undocumented WhatsApp groups where people would just exchange thoughts, opinions and unverified experiences without professional help simply because it was expensive. The ideal situation would have been if they could have these resources at hand, to their reach without having to consult external partners, this was going to be cost effective, direct and would save on time and help make farming easy and enjoyable. Having to go to the department of research to get a consultant not only did it take a lot of time, it was also expensive, money had to be produced and there were bureaucratic tapes to acquire the information that the consultant has. Farmers normally do not have a lot of time at their disposal since their job require 24/7 attentiveness and less or no time can really be invested in proper

research on the diseases that would have attacked their crops. Research is generally a strenuous process and most of which they will not be sure with the diagrams if they are researching the proper thing or not and if the route of rectifying the predicament is the right one. This will eventually inconvenience the whole farming progress.

1.4 Research Aim

The aim of the mobile and web integration system was to develop an intelligent mobile system that will provide as much information about pests and crop diseases for the convenience of all the farmers. The system also aims to be cheap in terms of compatibility and other costs requirements and will have an interface that will be very easy to use. The web based application program interface aims to show spatial data for better analysis pertaining geographical location of where much requests of the pests and disease have been recorded and this will help stakeholders as the researchers and all the houses concerned about crop and livestock production to take necessary action to refute the spread of diseases.

1.5 Objectives

Once the problems were defined, there was need to set goals and this was going to be completed by a set of objectives. An objective is a prescribed convention of accomplishments, or a development used to improve as well as contrivance a new or improved information system (Gelinas, Dull & Wheeler, 2015). They represent steps along the way toward achieving the goal and are often called milestones directing the development of the system to eradicate the problem that would have been flagged.

Pertaining the problems that were stated above, a need to develop a system was raised that will do the following:

- To train the system to increase precision.
- To compare images with the diseases in the database with a 90% precision return
- To measure the system reliability via performance tests
- To group all untagged data images to help researchers update the system
- To self-learn from its mistakes, helping in disease precision

The system now has an integration of the mobile platform for the farmer and the web based platform for the other different stakeholders with differing user access for data manipulation and data sensitisation.

1.1 Instruments

The proposed product was augmented with the following tools:

- **A relational Database SQL and SQLite**

  It is a relational querying facility (quinStreet.inc, 2017). In this program it will be retrieving data and perform create, delete, update and retrieve operations.

- **Visual Studio**

  It is an assimilated development environ developed from Microsoft to augment software systems (MSDN.inc, 2017). It is going to be used to develop the custom vision of the system

- **Azure**

  This is a cloud application development environment which builds tests, deploy and manage the application (Microsoft.inc, 2017). This will be used for the imagery customization in the system.

- **Xamarin Studio**

  This is sophisticated development platform that has vast features for development of mobile application (Xamarin.inc, 2017). In this system it will be used for the responsiveness of the mobile environment.

- **Telerik for ASP.Net**

  This is a buffer environment that contains controls of information systems (telerik.inc, 2017). In this program it will be used to call events requested by users.

- **Android Studio**

  Aided with Xamarin Studio, this environment help develop the mobile version.

The proposed system was developed using the traditional system development life cycle as the methodology implemented since there was no other system developed to cater such a need.

1.2 Methods

For the development of the proposed system, three types of information gathering tools were going to be used which are observations, questionnaires and interviews. Observations are a methodology where the observer pays special attention to the activities being undertaken within the existing system. A questionnaire is another information gathering technique where there will be a list of questions where there may be three types of responses i.e. guided responses in form of a Boolean yes or no, semi- guided where responses are answered freely whilst being guided contextually. The last type of responses are the open one where the responder can actually write their own opinion without any guidance. Interviews are an exchange of two communicating parties in which one will be asking the other and the other responding to the questions asked (Scheyvens, 2014).

1.6 Justification

The focus is to develop a system that largely helps the farmer that all the crop diseases information and how to treat them will be in the palm of a farmer's hands and if ever there will be an outbreak for a pandemic, differing stakeholders like the veterinary will take quick courses to rectify the situation. This was going to reduce even the workload of farmers in looking for treatments and researching further, moreover they would feel eased when if they face new diseases or anything out of the scope of their knowledge or even the system's database they will know higher offices will be attending to the problem they would have conveyed. The farmers, were going to have convenience that is mobile, regardless of the location they will be able to find valuable information that will make their farming easier and will eventually raise the country's Gross Domestic Product helping the economy as a whole. Communication will be two way that less time is taken for information to reach the appropriate stakeholder if quick action is required This system will help the farming sector to be efficient and effective pertaining pest and disease control of which pests and diseases may be the most detrimental factor or constraint to achieving above optimal harvest. The system is web based system and this implies it refutes all the geographic and bureaucratic constraints that may rise. It is not held to one organization per say but instead even the stakeholders who are abroad and in other organizations are able to use this system for their convenience. The system will be augmented in such a way that information may be exported to pdf and or excel thus making is more convenient for the data retrieved from the

system to be integrated and be used in other systems by other crop production and animal husbandry houses hence building an ecosystem in the agricultural sector.

1.7 Conclusion

This chapter clearly identified the need to develop such a system objectifying the problems that the current regime was facing and the justification of why there is was need to develop such a system, what will be used to build the system and the probable constraints that may be faced during system development. The challenges that the farmers were facing have been identified and there the need to develop a system to help educate the farmers so they can yield greater harvests was raised. Succeeding to this introductory chapter, there was need to instantiate if developing the system was feasible. This was carried out in the planning phase, where there was a scaling of whether or not it is paramount to adhere to the development of the system. This plan determined the scheduling of tasks in the development of the system.

CHAPTER TWO: PLANNING PHASE

2.1. Introduction

In this chapter, a clear definition of the facets of the system were implemented. These included, its business values which justified the relative advantage of the proposed system over the one it supersedes, its technical, social, operational as well as the economic feasibility studies. Furthermore, this chapter projected a plan that will be implemented to manage as well as monitor the progress that the project is registering at every stage.

2.2 Business Values

Business values are a set of standards used to determine the company's worth that may include fair market value, intrinsic value as well as investment value. They determine the company's position in the long run (valueadder.inc , 2017).This system is helping the company by giving it a fast and convenient route to their vision that is be a leading research and facilitating board by 2020 (dr&ss.inc,2017). The following will show the business values of different stakeholders in the organisation wanted to be appreciated:

a) **Managerial Values**

Managerial values are values put as first or top priority by management and this organisation's managerial values include:

- Customer satisfaction: They wanted to ensure that the system met user requirements
- System Security: They wanted the system to be able to block intruder access
- Market growth: The system had to facilitate them acquire more customers
- Less operational costs: It was supposed to reduce operational cost in goal achieving for example labour.
- Profit- they wanted to realise benefit from the system
- Decision making- they wanted a verification if the visit is even necessary thus refuting users who may send new notifications that are not crop related

b) Organisational Values

Oganisational Values are those that are unanimously approved and inherently make the organisation better and profitable. For this organisation, these include:

- Competitive edge: Organisations seek to register progress over competition hence giving them autonomy in that market
- Balance: The organisation also seeks to acquaint all their employees with top technology that is effective and help produce more results helping the managerial values
- Accountability: The system had to have a specific range of responsibilities hence gaining responsibility for those tasks and answer to questions if raised

c) Stakeholders Values

These are what stakeholders refer to have paramount importance in investing anything in the organisation. Stakeholder in this context value:

- The farmers aspired to have an improved communication with the researchers without delay
- They also wanted to have immediate attention to what will be happening on their farms
-Farmers also require a reduction in the cost of acquiring information from the research experts.
- Researchers had to at least know what they will be dealing with before they reach the farm hence boosting productivity
- Researchers wanted a means not to repeat the same visits to farms they would have already gone to

2.3 Feasibility Study

When talking about feasibility study, there is focus on the plausibility of the project being completed, taking into account the economic, technical, and scheduling pointers (webfinance.inc, 2017). It is used to determine the positive or negative reproduction that the project may have before investing either money or time into the project. The feasibility study now concentrated on

economic, technical, social and operation aspects of the project.

2.3.1 Technical Feasibility

Technical feasibility checked whether the company has or can make acquisitions of the indispensable technology to support and instrument the proposed system (evirtualservices.inc, 2017). It looked at the software and hardware necessities as well as the expertise to augment the system until deployment.

2.3.1.1: Technical Expertise

What was gathered to ensure the technical expertise feasibility is made evident in the following:

- **Users (Farmers)**

  Farmers nowadays have smartphones amongst other gadgets, these have already been helping them on the meteorological forecasts and the support groups hence making the farmers technologically able to operate the system

- **Users (Research Administrators)**

  One of the employment criteria at dr&ss is computer literacy making all the researchers able to cope with the system.

- **Developer –** the developer spent two years on a hands on ASP.Net development including web and content management and is well acquainted with C# as it is the base language in the development of this system

- **Conservation Team-** the company has a well-equipped Information and Technology Department which will be able to see the future use of the system after deployment

Seeing that all the technical expertise required was available without any hazards of failure, it was confirmed that the project could proceed without complications.

2.3.1.2: Infrastructural, Software and Hardware Prerequisites:

To observe the success of the system being implemented, there was demand to add onto the already installed hardware and software. Amongst the materials required there was need to add the following:

a) Hardware

The following are the hardware specifications that the system required:

Table 2.1: Hardware requirements

Item	Quantity	Available	Decision
Dell PowerEdge T20 Server with Quad Core processor,1600MegaHatz Memory Speed, 32Gigabyte SATA HDD Memory and Intel Graphics P4600	1	0	the organisation will procure a new server
Dell Latitude Laptop with 750GB Hard Drive, Core i5 processor and 4GB RAM	3	0	The organisation will buy at least 3 laptops.
Mobile Simulator with Quad Core Processor, 8 GB Space	1	0	A new simulator will be bought
D-Link Wireless Router DIR 615	1	0	a new router will be purchased

b) Software
- A relational Database SQL and SQLite
- Visual Studio
- Azure
- Xamarin Studio
- Telerik for ASP.Net
- Android Studio

The requirements were acquired and there is assurance that the project can go ahead with developing the system.

2.3.2 Economic Feasibility

Economic feasibility is defined as the measure of profit per each unit of capital, where the net profit is the profit remaining after deducting all the operational costs incurred by that unit. It expresses how much return is being benefited from capital (Ghosh &Kumar, 2003). In developing the system, the research focused on the possibility of the benefit to develop the system. This was evaluated from an accounting perspective which focused on the Cost Benefit Analysis and an Investment Analysis. There was a means to evaluate basing on cash flow that has been projected as shown in the following:

2.3.2.1 Cost benefit analysis

This analysis method identified the probable gains and probable losses, converted them into monetary terms and weighed them against the measures of decisions to determine if the development of the system was desirable (Gent, 2009). Since most costs could not be quantified in monetary terms, an estimation method was used to assign money values. Below is how the costs and benefits were clustered:

2.3.2.1.1 The Costs

These are system related incurred in both the development period as well as the maintenance of the proposed system.

Operational Costs: These are costs that would be incurred in the day to day operations of the business. They can be fixed or variable, fixed being those that have a close to immutable charge and variable being ones that are proportionated to the usage unit (webfinance.inc, 2017). The following represents the operational costs that the system may incur as operational costs:

Table 2.2: Operational costs

Operational costs in $USD	Year 1	Year 2	Year 3
Operational expenses	1 000	1000	1000
Maintenance.	3000	2000	2000
Training	1 000	700	400
Printing	300	300	300
Stationery	500	500	500
License and upgrades	200	100	100
Total	**6000**	**4600**	**4300**

2.3.2.1.2 Development Costs

These, as defined from the name were incurred during the augmentation of the system and were estimated before the beginning of the project and later reviewed and refined, at the end of each phase of the project (accountingcoach.inc, 2017). Such costs included developer transport, food, training and new equipment. Development costs are to be shown in the following table:

Table 2.3: Development costs

Development Costs in $USD	Year 1	Year 2	Year 3
Dell PowerEdge T(20) Server	1 900	1900	1900
Mobile Simulators	600	600	600
Dell Latitude Machines	1 600	1600	1600
Wireless Router	500	500	500
Personnel training	300	200	100
Total	4900	4600	4500

2.3.2.1.3 The Benefits

There are two types of benefits, tactical and strategic benefits. Tactical benefits are benefits that improved the working space and social responsibility factors which may affect the company as a whole. Strategic benefits now helped in better performance of the company, cutting costs and they are long term. The benefits' tangibility was dependable and the tangible benefits include cost reduction, less customer churn and stakeholder satisfaction. Intangible benefits may include goodwill and better decision making. The benefits of the proposed system were forecasted to the following quantifiable amounts:

Table **2.4 System benefits**

Tangible benefits estimated amount in $USD	Year 1	Year 2	Year 3
Less Paperwork	4500	4700	4500
Better accuracy of accounts	1000	1500	2000
Less Consultancy	600	600	500
Less Running Costs	1500	1100	2000
Intangible benefits	6 000	5000	4500
Total	**13600**	**12300**	**13500**

2.3.2.1.4 Cost Benefit Analysis

Since the costs and benefits had been detailed. The following is the full analysis of the cost versus the benefits to further justify as to why the system was developed:

Table 2.5: A Cost and Benefit Analysis Table

Benefit / Cost in $USD	Year 1	Year 2	Year 3
BENEFITS			
Total Benefits	**13600**	**12300**	**13500**
COSTS			
Development Cost	**(4900)**	**(4600)**	**(4500)**
Operational Cost	**(6000)**	**(4600)**	**(4300)**
Total Costs.	**(11000)**	**(9200)**	**(8800)**
NET BENEFITS/LOSS	**8000**	**3100**	**4700**

From the cost and benefit analysis table, it can be seen that the system is feasible and it is profitable to pursue with the development of the system. The profits start to diverge as years pass:

2.3.2.2. Investment Analysis

A lot of methodologies were implemented to show comparison of projects with their cash flow forecasts. In this research, two were used which included:

- Net Profit
- Payback Period
- Accounting Rate of Return
- Net Present Value

a) Net Profit Analysis

Brent (2007), describes net profit as the comparison of the turnover and the cost of sales as well as the operating expenses and for this project is calculated as follows:

Net Profit = Total Benefits less Total Costs

Table 2.6 Net profit over 3 years

	Year 1	Year 2	Year 3
Total Benefits	13600	12300	13500
Total Costs	11000	9200	8800
Net Profit	**8000**	**3100**	**4700**

The Net Profit of this particular project is **$8000USD** for year 1, **$3100** for year 2 and **$4700.**

b) Payback Period

This refers to the amount of time it takes for a project to return the initial investment outlay. It is measured in time and the following elaborates how the system will pay back the investment, Brent (2007). The following is how the system was to pay back.

Total Investment Cost – Net profit per year

⇨ $11000 + 9200 + 4700$

Table 2.7 Payback Period

Total Investment Cost	Value	Balance
Year 0	24900	24900
Year 1	13600	**11300**
Year 2	12300	
Year 3	8800	

11300 / 12300 * 12 months (to confirm how long in a year was the investment paid back)

11.02 months

The project has a short payback period of **1 year and 11 months.**

    c) Accounting Rate of Return (ARR)

According to Brent (2007), this can also be termed as Return on Investment and is used to make comparison between the profit and the capital invested. It was calculated as a percentile of the profitability as follows:

ARR = (Average Annual Profit/ Total Investment)* 100

        Where Average Annual Profit = Net Profit/ Number of Years

For this project the Average Annual Profit   = $8000/1

    ⇨ $8000USD $3100 $4700

And ARR   is:

    ⇨ (8000/11000)* 100   (3100/9200)*100   (4700/8800)*100
    ⇨   **72.73% (Year 1)**   **33.7% (Year 2)**   **53.53% (Year 3)**

As the Accounting Rate of Return is positive,

From the methodologies used, it is clear that the proposed system was economically viable as the benefits are more than the costs.

d) Net Present Value

Net present value refers to monetary value at a particular time. It checks the present value of the benefits versus the outflow of the system (Hopkinson, 2017). The following is how net present value was realized as follows:

Net Present Value => Total Benefits less Total Costs/ (1+ r) ^n

Where R is the Interest Rate and N refers to the number of years

- ⇨ (13600 +12300 + 13500) – (11000 + 9200 + 8800)
- ⇨ 39400 – 29000 = 10400
- ⇨ 10400/ (1+ 0.10)^3
- ⇨ **$ 7813.67**

The net present value after 3 years will be $ **7813.67.** This proved as the other reason why the system proceeded to development.

2.3.3 Social Feasibility

Hillson & Simon (2007) define social feasibility is how the system will be interacting in the community where it will be implemented and weighing the effects of what the system will produce whilst being implemented. This application has more merits to the community at large. Zimbabwe as an agro economy, will appreciate much of what this system will bring because it relates to what most citizens do in Zimbabwe. It was of more benefit since it started to enhance the development of communities. The system is easily maneuverable since it can be used by anyone and manages to inform anyone from novice to expert from a click of a button.

2.3.4 Operational Feasibility

Operational feasibility examines the support and acceptance of the system by users, management, and overall stakeholders (Boehme, 2011). In full confirmation of whether there was a go ahead or not, checks were made using questionnaires and interviews to verify if there is solid reasons to develop such a system. Management even furthered to mobilization of delegate to see through the success of the project. The finance department, as they are concerned about the cost benefit of the project, looked seriously at the project and gave it a go ahead. They saw it

beneficial to the financial returns of the company. The farmers as the primary users were ecstatic to this venture since they always complained about the procedures and costs as well as the time they had to factor to acquire professional knowledge. The Information Technology department management saw this research as a technologically forward project and since it will be an expert system it will position the whole company at a forefront when it comes to technology, which is the Information Technology Strategy that the company has to technology alignment. Every interested party was in full support of the research.

2.4 Risk Analysis

There is an element of risk in the development of every system and this may affect success of the project. Proactively, risks were identified and monitored as well a strategy for contingency plans to mitigate them. Risk mitigation saves from loss of unnecessary costs, awareness of the risks thus implementing standard so as to help save time and other available resources. Risks in system development can be classified as Technical, Economic, Security risks other risks may be categorized independently. Below is further exaggeration of the clusters of risks that may affect the project and well as how to mitigate them.

2.4.1 Technical Risks

Apart from the fact that there is an effective two way communication between the developers and the users, there was a possibility that the interface will be too complicated for the users or have less of what the user requires. To refute this, a prototype was developed and probed the clients further as to what exactly they needed as well as facilitating the best infusion by training and allowing room for errors thus developing the best product that will be exploited to its full capacity.

2.4.2 Economic Risks

Restrictions on the cash flow towards imports as well as limitations of imported goods left the company at a bruised position. The main problem is situated towards the purchase of software and hardware that is needed to develop the system. To ensure this risk did not affect the project, the company purchased from local traders.

2.4.2 Security Risks

Technology has its disadvantages, the server may crash and wipe all the data. To ensure there was very low risk, partition of the server into backups and backup of backups thus there was third degree mirroring and no loss of information. If it so happens that there are attacks from viruses and other Trojans and malware, an additional cost of purchasing a licensed antivirus which helps protect the firewall and other sort of malware that may attack the system. To avoid distribution of confidential information to the public, the system came with authentication to access the system and access level to avoid this.

2.4.3 Other Risks

Some other risks including the quality assurance of the product and to do away with this risk, was refuted with a strong adherence with the Information Technology Standards that governs the Software products of Zimbabwe as well as hire an external Assurance Officer who will benchmark and weigh the quality of the product developed. Technology alignment may also be a problem so to mitigate this risk, high technology diffusion was instated to ensure the best infusion of the system, the farmers and other stakeholders were made aware in earnest about the system and be educated on how to use the system. There was risk that the system will not be done in time so to reduce this, the developer stayed focused on the development of the system.

2.5 Stakeholder Analysis

Stakeholder analysis was defined by Mapfumo (2003) as the technique used to identify the key people that are there to ensure that the project is being put into path as well as seeing through the success of the project. It has three steps which include identifying, prioritising and lastly understand their key needs. For this project there are three key stakeholders which are the farmers as the customers, the researchers and the management of the company. Their expectations are stated below:

a) Farmers

Since they are guaranteed major stakeholders, they were hoping for a responsive system with real time information and reduction of the red tapes and other procedures they have been going through to get expert information. They also expected an easy to maneuver system with a platform that is comprehended by a lame man with little to no skill of using a mobile phone.

b) Researchers

Since most time was spent in going into the field as well as educating the agricultural extension workers through various long workshops to advance their knowledge base as well as seeking approval from the relevant ministries in the government. Upon familiarizing about the proposed system, they expected the system to cut all the procedures they spent going to the government offices and back as well as the workshops which were eating up their research time which was the time they spent in the labs discovering new things about the pests and diseases.

c) Management and Supervisors

They were the ones who are facilitating the success of the system with confidential information. They expected the name of the company to be withheld with integrity and maintain the standard they have had and see that the vision is a step closer to being apprehended and brought to life. They expected the system not to break any laws fraudulently or not as well as facilitate that the farmers, the government, the researchers are happy with the system

2.6 Work Plan

Every lifecycle have to be given a span from which a detail beginning and ending of activities will be stipulated. The project was done in stages where one stage succeeded after the precedent phase has completed. A work plan had to be conventional to keep track on the progress of the project development. There was a schedule table showing the date a phase begins and when it will end followed by a Gantt chart

Table 2.8 Activity Work Plan

Activity	Duration (weeks)	Start Date	End Date
Investigations	4	22-02-2017	29-06-2017
Planning	4	30-05-2017	06-06-2017
Analysis	4	07-06-2017	06-07-2017
Design	4	15-07-2017	06-08-2017
Implementation	4	07-08-2017	14-09-2017
Evaluation	3	15-09-2017	16-10-2017

The information that is being shown in the work plan above is also to be represented in form of a Gantt chart as follows:

Table 2.9 Gantt chart

Activity	4	8	12	16	17	19	20	24
Investigations	■							
Planning		■						
Analysis			■					
Design				■	■	■		
Implementation							■	
Evaluation								■

Activity Time (weeks)

2.7 Conclusion

In this chapter, a feasibility study was done clearly pointing out the technical, economic, social and operational feasibility. Furthermore, a risk analysis was done identifying and giving counter actions to be implemented in the event of those risks occurring. Thereafter, a work plan was stated as to how the system. Succeeding to this chapter, there will be analysis of the system where the research will look at the information gathering and analysis of the current system and evaluate the alternative as well as a requirements analysis.

CHAPTER THREE: ANALYSIS PHASE

3.1 Introduction

In this phase a definition of the requirements of the proposed system was done. It expressed the issues that the system aspired to achieve. In this phase there was a focus on the information gathering, analysis of the current system. A clear cut showing of the weaknesses of the system and evaluation of the alternatives on the plate and make a requirement analysis was detailed. The system needed to be dissected and have a notion of what needed to be deciphered. This segment surveyed the current system via qualified tools as the context diagram and a dataflow diagram.

3.2 Information gathering methodologies

The development of the system had to be cited with a perspective of how the existing system operated. There was also stiff investigation of problems that caused the rise to a new set of options that users felt they should use in the new system rather than keep implementing the old system (Craig, 2008). This system needed to produce an ease of knowledge syphoning of expert information to the farmers also addressing the complex procedures of acquiring the information. To determine all the factors, the following methodologies were used.

3.2.1 Observations

Observations are meant to conceptualise the existing system as one of the decision making methodologies that are used in system development (Friesen, 2010). These observations were done to get a subjective view of how the farmers were handling the current system as well as the company. It also helped figure out how they responded to the farmers and how they conducted their business functions. Observations helped observe how they feel about the system by forms of the expressions made during their day to day use of the current system. This was important as these are the biggest stakeholders and not prioritising their needs will critically cripple the success of the system. The farmers were disgruntled over the long wait they had to take to acquire professional information. They resorted to using undocumented social media platforms to help themselves which was not enough guarantee that the information is legit. For information acquisition, they had to pay to attend seminars hosted and this whole process wasted valuable time they could have spent working on their farms. Some farmers would not even attend these meetings because they felt as though they could not delegate enough time to

attend and hoped to be told over an informal gathering after farming hours.

a) **Advantages**

- It provides a hands on access to the existing system
- It was flexible, flexible working hours, flexible perspective of opinions of the system
- It complimented other methodologies by aiding conceptualizing how to implement the technologies

b) **Disadvantages**

- It did not give full detail and reason why some actions were done
- It was subject to bias, compromising the quality of the data that is being gathered
- Observer influenced behavioral change to the farmers and the researchers.
- Required a comprehension of how the system works, the standards and policies set to help gather valuable data

3.2.2 Questionnaires

These involve drafting a list of printed questions structuring them such that they can be responded on with choice of answers (Dorneyei, 2014). This was done using paper and a survey monkey to the farmers and the research board. The papers and survey links will be distributed to all the stakeholders targeted by this system. The farmers' questionnaires looked at the standardized questioning of how they found the existing system as well giving suggestions as to how they would improve the system this is the same for the researchers in the research board. Management questionnaires also made proposals to the new system they felt could be incorporated to the enhancing of the business vision. Questionnaires gave the new system an opportunity for maximum exploitation and customer satisfaction.

a) **Advantages**

- Standardized information gathering, it avoided ambiguity saving time and cost
- They were distributed and collected by anyone hence increasing productivity
- Weighing which route would satisfy most clients from the comparison of the answers was brought about
- They helped create new hypothesis and helping bring new ideas to better satisfy the farmers

b) Disadvantages

- With questionnaire, no body language was established hence compromising the quality of information gathered

- Important questions may have been missed on asking deeming the questionnaire irrelevant

- They are written, farmers and researchers chose to interpret differently one question

3.2.3 Interviews

This is a discussion between two parties one being the interviewer, who is the one who asks the questions and the other being the interviewee, who responds to the questions (Polak ,2016). This methodology aims at helping make appropriate action validation of the responses giving more information about the value of the response. This is to exhaust all the other skills that are needed to get as much information as possible and has the ability to probe further as well as simplify terms to both the farmer and the researcher as to what some questions imply. The interviews were done to find out the challenges the farmers were facing before using the research system that was already being implemented by the board.

a) Advantages

- There was discovery of other non-verbal actions which indicated more to the responses
- The interviewer had the ability to probe further to get quality data
- There was room for the interviewee to ask questions
- More information was gathered as speaking is faster than writing

b) Disadvantages

- Respondents would fraudulently give wrong data to please the interviewer, hence subject to bias
- Most farmers were not well acquainted with technological terms making the interview long and hard to conduct

3.3 Analysis of existing system

The system that was there was manual cited at one center that is the head office. The system did not have a computerized system for the distribution of information. For this reason, there was a file system that was apprehended for the farmers who would come to the organisation. At the end of a month, there were appraisals of the visits the researchers had made in that month in an excel sheet. The farmers on the other hand have to commute to the head office of the company to gather information and help about diseases. The following things happen:

- **Researchers' visits**: When farmers would want on the ground help, they would book dates to come to the company and hire a researcher and pay per man hours. Actual visits for the booking have to be done physically. This implied the farmer had to commute from the farm to the organisation.

- **Approval of Visits**: Information about the visits had to go through a chain of signatures for approval. The manager would manually assign a researcher to a farm and day to be spend after estimating the amount of work to be done on that farm.

- **Researcher's new findings:** If there was a pandemic in a region after the researchers and the agricultural extension workers have verified the outbreak, there had to be letters to the ministry of agriculture to approve strict checks on the diseases. Workshops were then held to inform the agricultural extension officers thus they syphon information to the farmers.

- **Researchers' feedback:** For the researchers to confirm if the outbreaks have been controlled. They had to manually be on the ground and assess the information on the ground with help of the agriculture extension workers.

The following are the inputs, processes and outputs that were in the organisation:

a) **Inputs**
- Farmers details (name, contact number)
- Farms(size, address, owner, produce)
- Researcher's appointment(date, time spent)
- Agriculture extension workers(name, contact number, ward district)
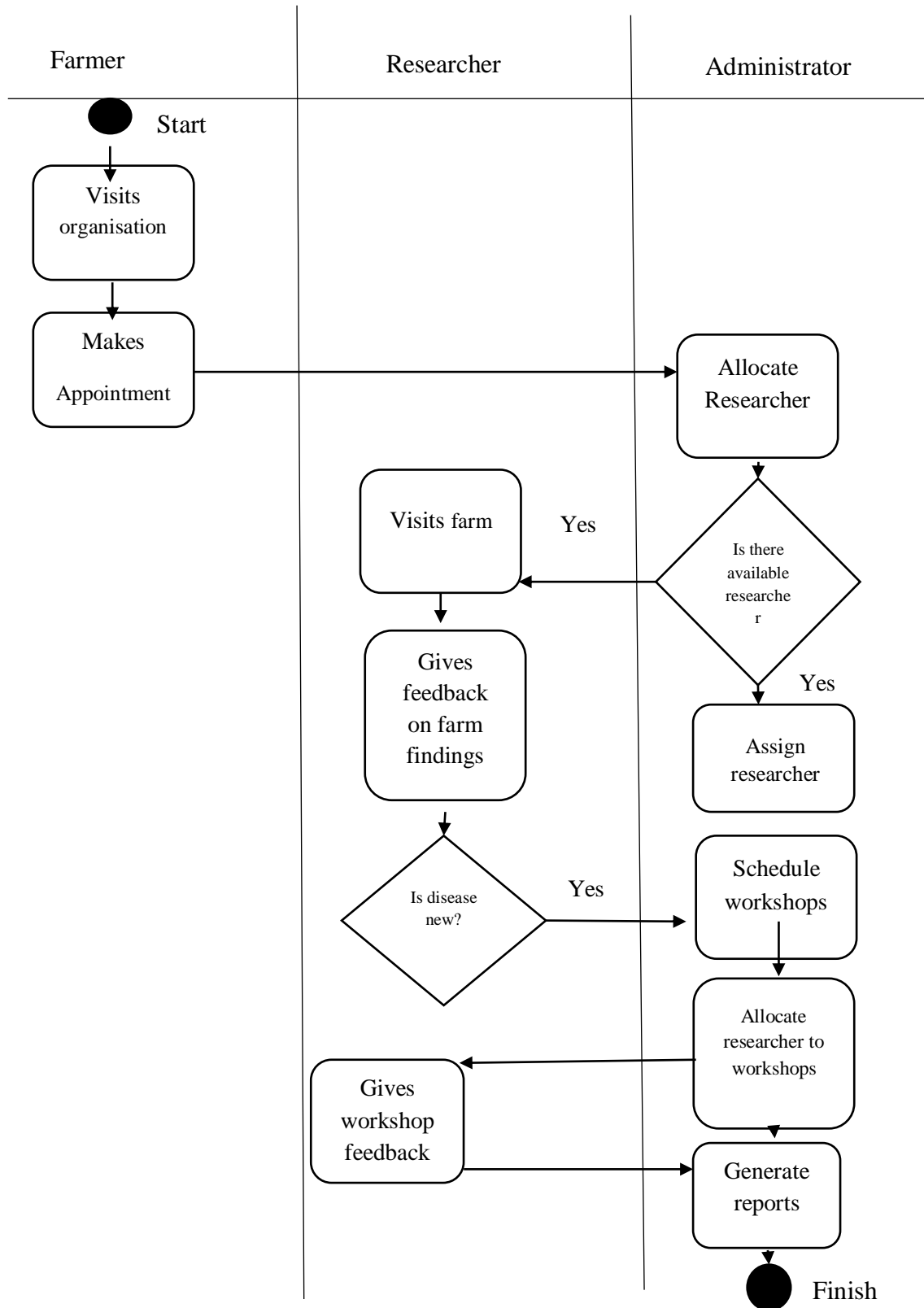
b) Processes

- booking of researchers to farms

- schedule workshops

- research for pandemic mitigation and control

- farm disease assessment

- preparation of reports

c) Outputs

- Appointment records

- Receipts of appointment

- Reports from farms and workshops

- Farm statuses (disease free, pandemic affected etc.)

3.4 Process analysis

This is breaking down the phases a workflow process conveying all the input, operation and outputs taken on each phase. It is used for improvement of process understanding hence determining the targets that are potential and removing redundant inefficiencies (webfinance.inc, 2017). This is shown diagrammatically in an activity diagram which will control the flow from one activity to another. An activity diagram shows states and transitions in-between the activity states. It can be branched, sequential or concurrent using elements like forks or joins (Jalloul, 2004). The following is an activity diagram depicting the activities that were exercised in the organisation:

Farmer | Researcher | Administrator

Start

Visits organisation

Makes Appointment

Allocate Researcher

Is there available researcher

Yes

Visits farm

Yes

Assign researcher

Gives feedback on farm findings

Is disease new?

Yes

Schedule workshops

Allocate researcher to workshops

Gives workshop feedback

Generate reports

Finish

30
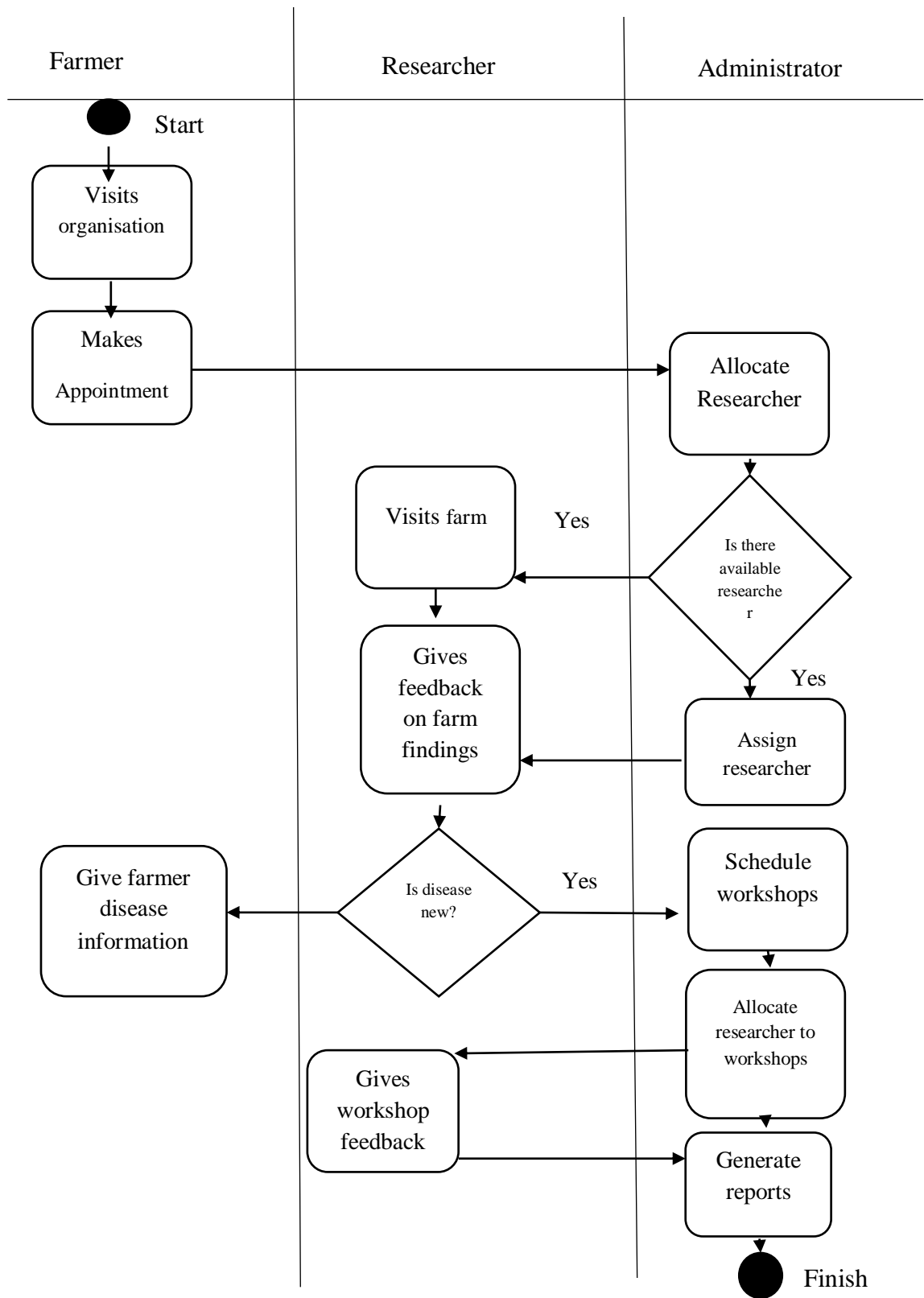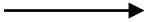
Figure 3.1 Activity Diagram

Key to the diagram:

(rounded rectangle)	Activity
→	Flow of an Activity

3.5 Data Analysis

Haining (2003) described data analysis as the activities and the processes where the user expectations are identified. The user may be able to classify, outline, postulate and unify the elements that are obligatory to placate the expectations. From these elements there was structuring of inductive extrapolations to differentiate the proposed and existing data. Amongst the methods used are a dataflow diagram and a system context diagram. A dataflow diagram is a graphical presentation of data modelling the process aspects as well as the inputs and outputs from the system (irs.gov, 2017). A system context diagram is graphical representation of the boundaries that are there between the system and its environment displaying the entities that are in interaction with it.
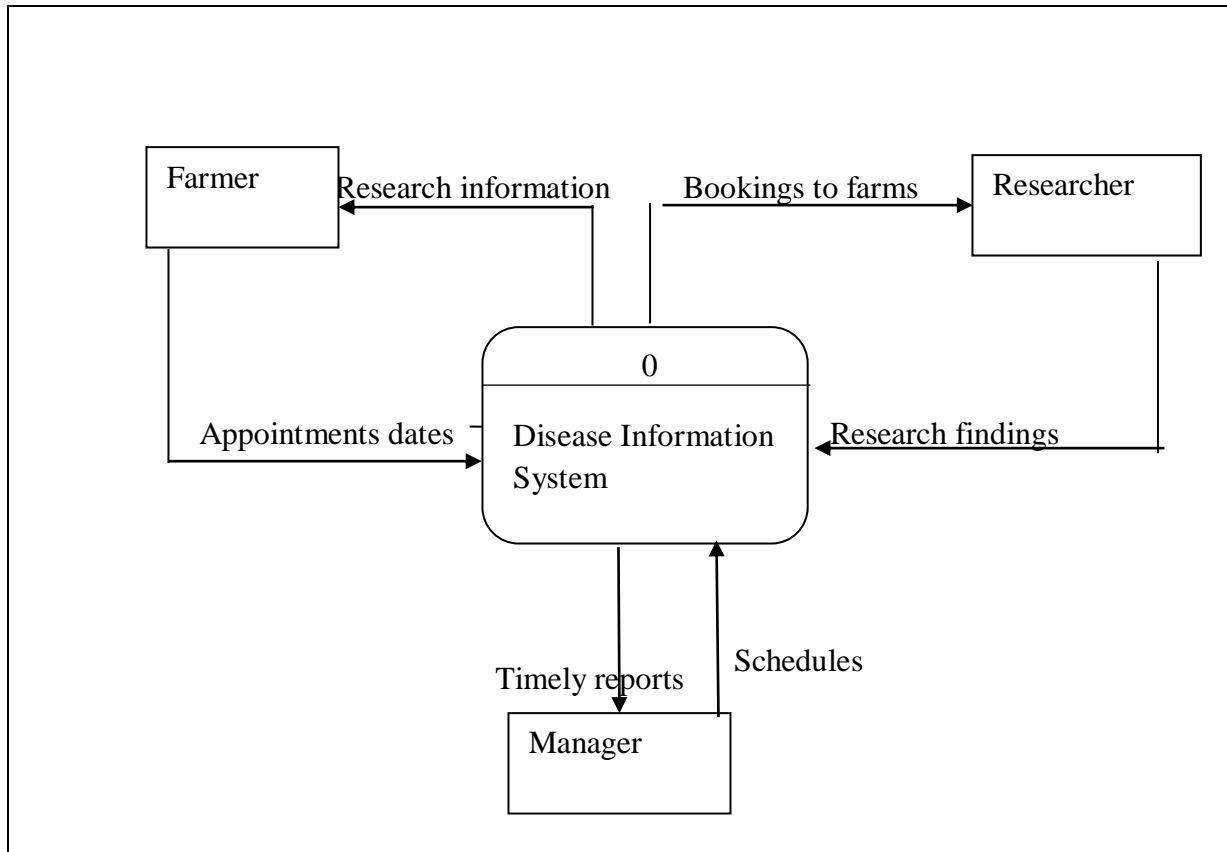
(Russell & Cohn, 2012). This is how information is conveyed in the organisation.

Figure 3.2: System Context Diagram
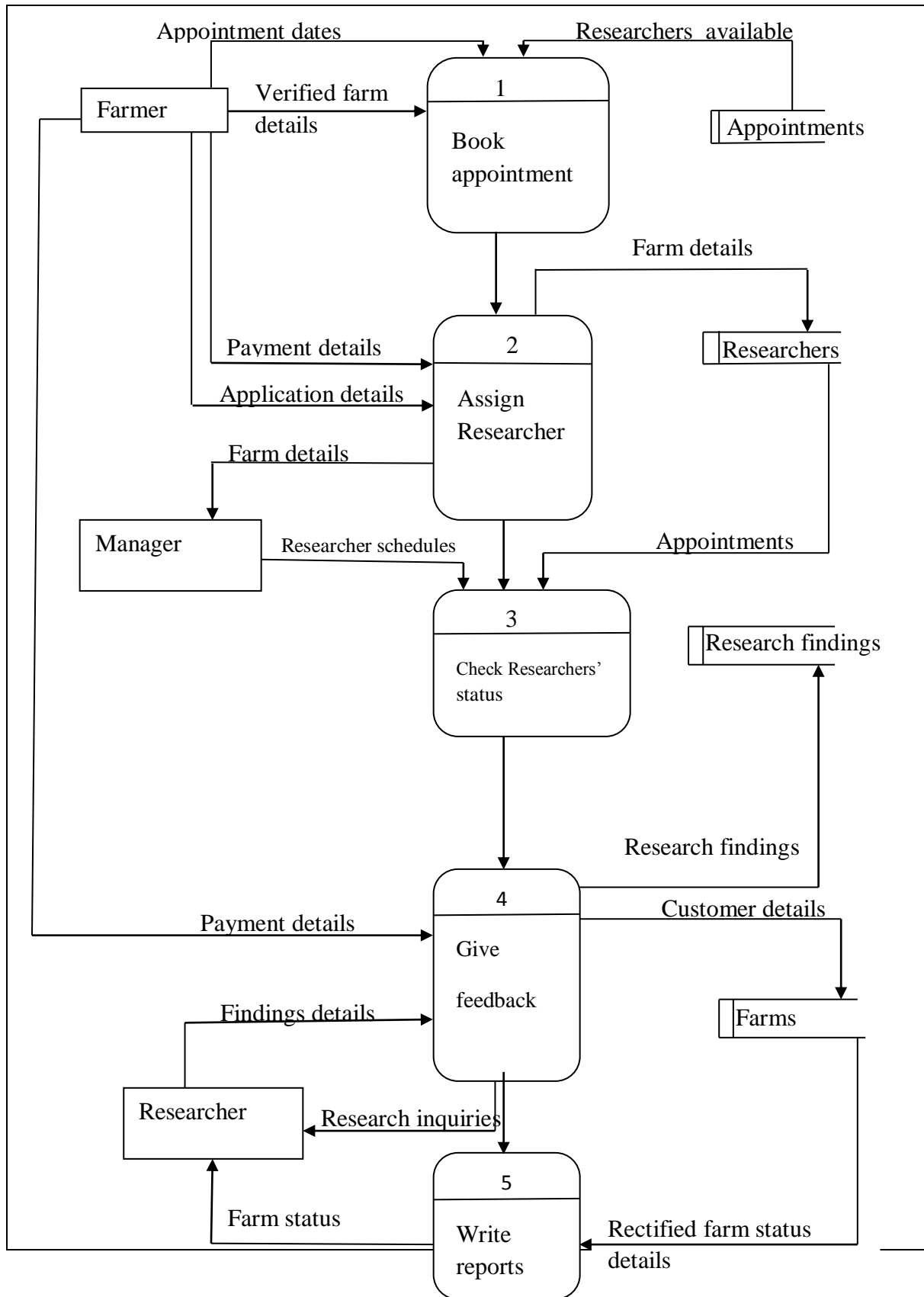
Figure 3.3: Current System Data Flow Diagram

Key to the diagrams

	Data Store
	Data Flow
	Process

3.6 Weaknesses of current system

- Records were never up to date
- There was duplication of appointments
- Assignment of an already assigned researcher
- So much paper use hence caused a lot of stationery costs
- Slow reaction to the disease via the long tapes to acquire expert help
- The system was manual and was vulnerable to a lot of errors
- Required consistent monitoring
- No security, information was held in files hence anyone can access it

3.7 Evaluate Alternatives

From the well held feasibility, all the stakeholders gave a go ahead to the augmentation of a new system. The weaknesses of the old system had to be mitigated in order to maximise production hence increasing the gross domestic product (GDP) of the country and eventually better economic growth. Numerous ways of developing an alternative computerized system and within the alternatives were used and included the following:

3.7.1 Improvement of the existing system

Another alternative will be just improving what is already there, fixing the areas of concern. This was going to yield advantages but did not in overall improve the system, it still has the same process functions and remain monotonous and ineffective. Even if the loopholes were covered and the system is improved, this alternative was not suitable because of the following reasons:

- Upholstering the system implied more costs in upgrading the system
- There would be much weight on the employee workload because there may be some immutable facets of the system
- For the reason above, it will implied a file system was still being used in one module of the system
- Failure would compromise security and confidentiality of the information as well as business functions

3.7.2 Outsourcing

This is contracting an outsider of the organization to handle business functions and or activities. This may include software augmentation, infrastructure, support and maintenance (Ashely, 2008). In this project was done for the following arguments:

- It implied no risk of system failure
- Maintenance and support was to be entirely repatriated to the outsourcer

However, because of the following reasons it was not used for this particular project:

- Research information is patented and confidentiality is key so outsourcing would have increased vulnerability of information security breaches.
- Managers would have lost control since the outsourcer would have different standards
- The organisation was going to be susceptible to accounting to unconfirmed costs since external costs are directly variable to additional costs
- Quality assurance is compromised since the outsourcer may compromise the product to maximize profits
- Contracting activities implies ensuring the well service of another organisation and this is detrimental to innovation and cost reduction especially in this economy.

- Outsourcing would have demotivate the personnel in the information and technology department
- It was generally more costly, because the outsourcer included a mark-up onto the product developed

3.7.3 Total Insourcing

Insourcing is performing all business functions that can be given to an outside contractor, within the organisation's departments (Theodosios, 2014). Schniederjans, Schniederjans & Schniederjans, (2015) furthered by saying insourcing can also be defined as hiring or bringing in a third party outsourcer to work within the company facilities. Though there may be technology lags within the organisation, it induced effort in developing the information technology department. Doing so, will enable the organization to bridge efforts and the probable success attached by information technology alignment. Using this way, the organization had to develop its own customized system, this deemed this way the best alternative because of the following reasons:

- The system had to customized hence synching with the business needs of the organisation
- It had cater for all farmer and researcher requirements
- Cost reduction in consultancy which is inherently expensive
- Due to the security of information issues as well as patents to new finding, it was important to develop internally.
- It does needed transparency of all costs.
- Development equipment capacitated the use of the system in future projects without reacquiring the products.

3.7 Requirements Analysis

Hay (2011) exemplifies requirements analysis to the process of pivoting the expectations of the user with the new system. It is also termed as requirements engineering and the requirements are mandated to be quantifiable, detailed and relevant. There are functional and non-functional requirements. Requirement analysis showed the stakeholders and their role in the system in form of a use case diagram as shown:

3.8 Use Case

The following is a use case diagram represented in a logical concept form. It shows the actors in the system which are the stakeholders, these actors perform use cases. In this system there are:

I. **Farmer** – this represented a regular customer who access the database using a mobile phone

II. **Researcher**- this actor would be working with new research areas from the farmer

III. **Administrator**-was managing the trips made by the researcher as well and allocate researchers to farmers
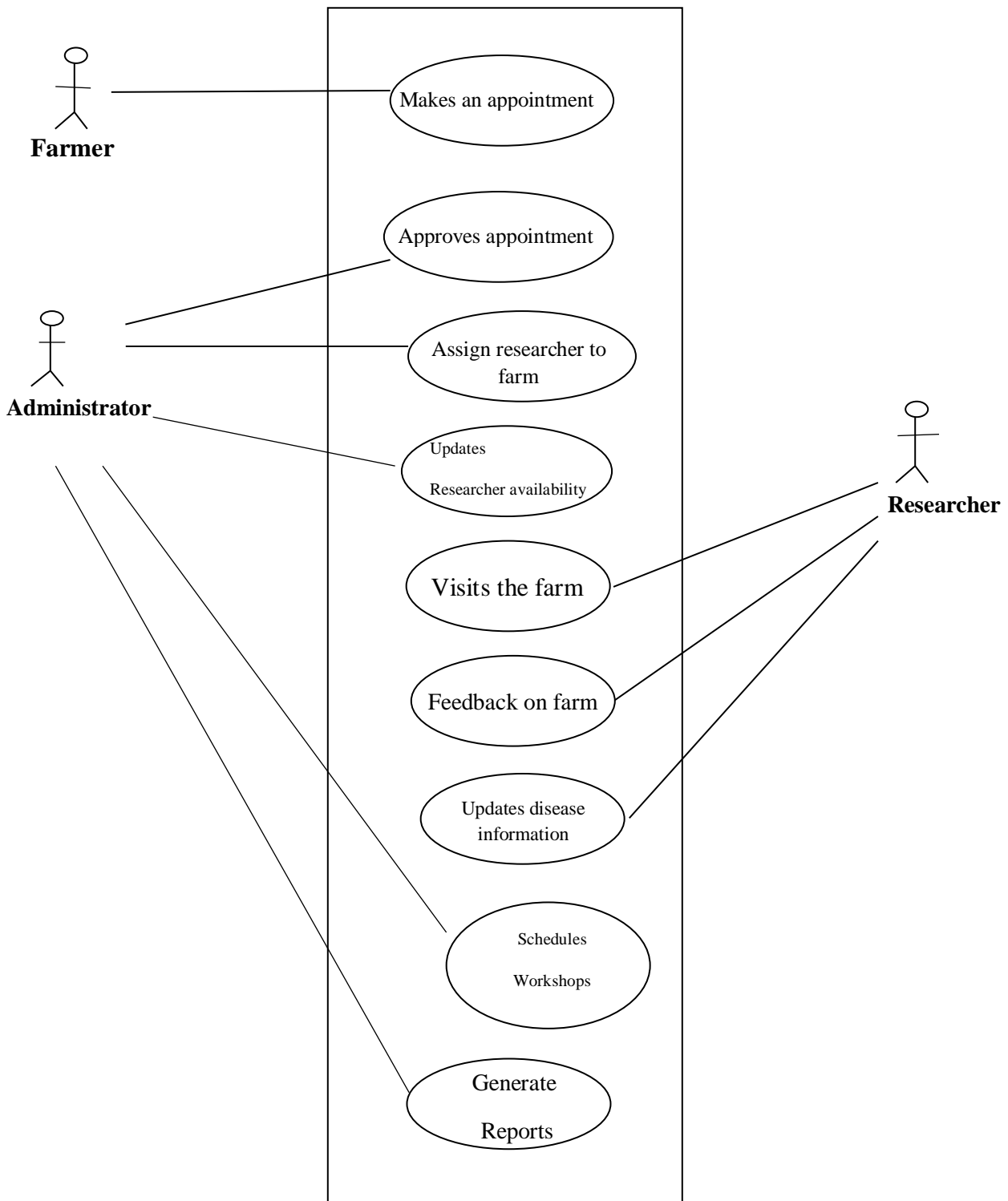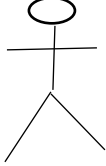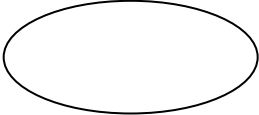
Figure 3.7 Use Case Diagram

Key:

Component	Meaning
	Actor
	Use Case

3.8.1 Functional Requirements

- **Central Database**: There was going to be a central database that runs simultaneously and concurrently for multi user thus all updates will be done at the same time and refute all the update issues.

- **Security**: The system would be having security features such as access levels and encryption of confidential information.

- **Report Generation**: Feedback of findings is of paramount importance in the organization. From this understanding the system needed to generate of accurate reports. These reports were going to be used by management and external stakeholders as the government.

- **Real Time Expert Information:** The system had to be in real time as well as mobile hence bringing real time information and assist the farmers immediately.

- **Verification and Validation:** The system underwent both black and white box testing to ensure that it cannot be tempered with or manipulated with by any unauthorized user. This was for confirming the efficiency and reliability of information

3.8.2 Nonfunctional Requirements

- **Interface of the System**: the system is easy to use to avoid and reduce confusion as well as support costs and assistance from the IT department. It also came with a manual showing stakeholders who use the system how to use the system.

- **Backup**: There is a possibility that the system will crash and or be susceptible to information loss and it may be hard to retrieve. It was of paramount importance that the system have a backup which is done at frequent intervals.

- **Exception Handling**: There was enough validation to allow the possibility of error making, such as not entering a required field.

3.9 Constraints

- The most probable constraint was the issue of time and convening organizations to intercommunicate to produce the best product for the farmers.
- Most farmers stereotypically are not technologically savvy and there was a probability that if not deployed well the system would be rejected by the most valuable client that is the farmer.
- The system needed to be deployed on android phones and this will imply there will need for the purchasing of new gadgets that the farmers may or may not have been preparing to do.
- An upgrade of even the stakeholder's machines was needed since computers with lesser specifications will not be able to host the system as it will be carrying big data.
- A purchase of a server or rental of server space was needed and this was costly.
- Internet connection may be slow in some farming regions as the service providers may not have set up boosters in those locations.

- Internet data charges will also be incurred as the farmers will need to download database updates and data using connectivity and in places with poor connections this may be detrimental to their overall activity.

- Licensing of some of the product that will be used may be a constraint since they are costly however these may be sunk cost at the end of the day.

- These constraints stated above may inherently be the cause of failure to deliver a product within the scheduled time.

3.10 Conclusion

This phase exhausted the analysis and requirements analysis of the current system clearly stating the weaknesses of the current system and evaluated the alternatives that are there. There was clear elucidation of diagrammatic representation of the processes that were being undertaken. After this there was the design phase which focused on architectural, physical, database, program and menu as well as security design. The phase looked at the pseudo code of the proposed system.

CHAPTER FOUR: DESIGN PHASE

4.1 Introduction

In the design phase a clear facet of how the projected system was going to be augmented and how it was going to be working was made. There was also a description of the system's software and software infrastructure as well as the other hardware that will be prerequisite in the architectural design section. In this phase there a clear concept on how the database and the interfaces was developed and designed.

4.1.1 Description of the proposed System

This system is a crop disease information system that help give farmer expert information. It allows farmers to capture the image of the disease and retrieve information about that disease. If there is a new disease that may have not been recorded it is flagged into the system and researchers can attend to it. Other stakeholders, as all the interested parties that have interests pertaining the farming sector and diseases can view the spatial data that will be displayed in the web based version of the system. The system came a few text and click only ensuring a simple to use system that can accommodate anyone who is not too savvy with technology.

4.1.2 Inputs

The system uses mobile phones, laptops and desktop computers. There is need of the Internet as well as printers if in any case a hardcopy is required. Information is saved on a strong Microsoft Server.

4.1.3 Processes

The proposed system gives expert information by a click of a button. It eradicates all the maneuvering from geographical places that was in the existing system. There is an all-electronic processing of every request and information will be retrieved by a click of a button. The system being digital, transformed the inputs accurately and efficiently into outputs.

4.1.4 Outputs

The farmers as presented before retrieves expert information by a click of a button. There is disease data that will be represented using co-ordinate form. There reports data that can be used by management to make planning and disease mitigation decisions

4.2 Systems Design

Systems design being a rigorous and systematic approach to materialise the objectives of any system development, it will show how the system was developed and how it is executing. The proposed system does number of functions which include:

- Capture a crop image and retrieve information that is particular to it
- Report images that is not assigned to any disease in the database.

The design phase basically emphasized on the following:

I. **The Efficiency of the system**

   It answers the question, does the system meet the user requirements since it was augmented upon the robust analysis of the existing system.

II. **The Functionalities**

   The system had to give the required functionalities specified in the user requirements and can be modified to further meet the requirements.

III. **The System User Friendliness**

   The system had to be simple to use giving less to zero consultations.

IV. **The Security**

   The system had to be robust against any security breaches giving access to authorized users. This was ensured via the use of passwords and access levels.

V. **The Performance**

   It should have performed with accordance to a set of standards that it is expected to do so.

4.2.1 Logical Design

This phase looked at how the system was functioning and modeled the processes that were incorporated in the system. This was done through a context diagram which is also known as a level zero dataflow diagram showing system scope and boundaries and a dataflow diagram

(Rosenablatt, 2013). A dataflow diagram is an object oriented analysis mapping out the flow of information in a system (Rajaraman, 2011). These diagrams are represented as follows:
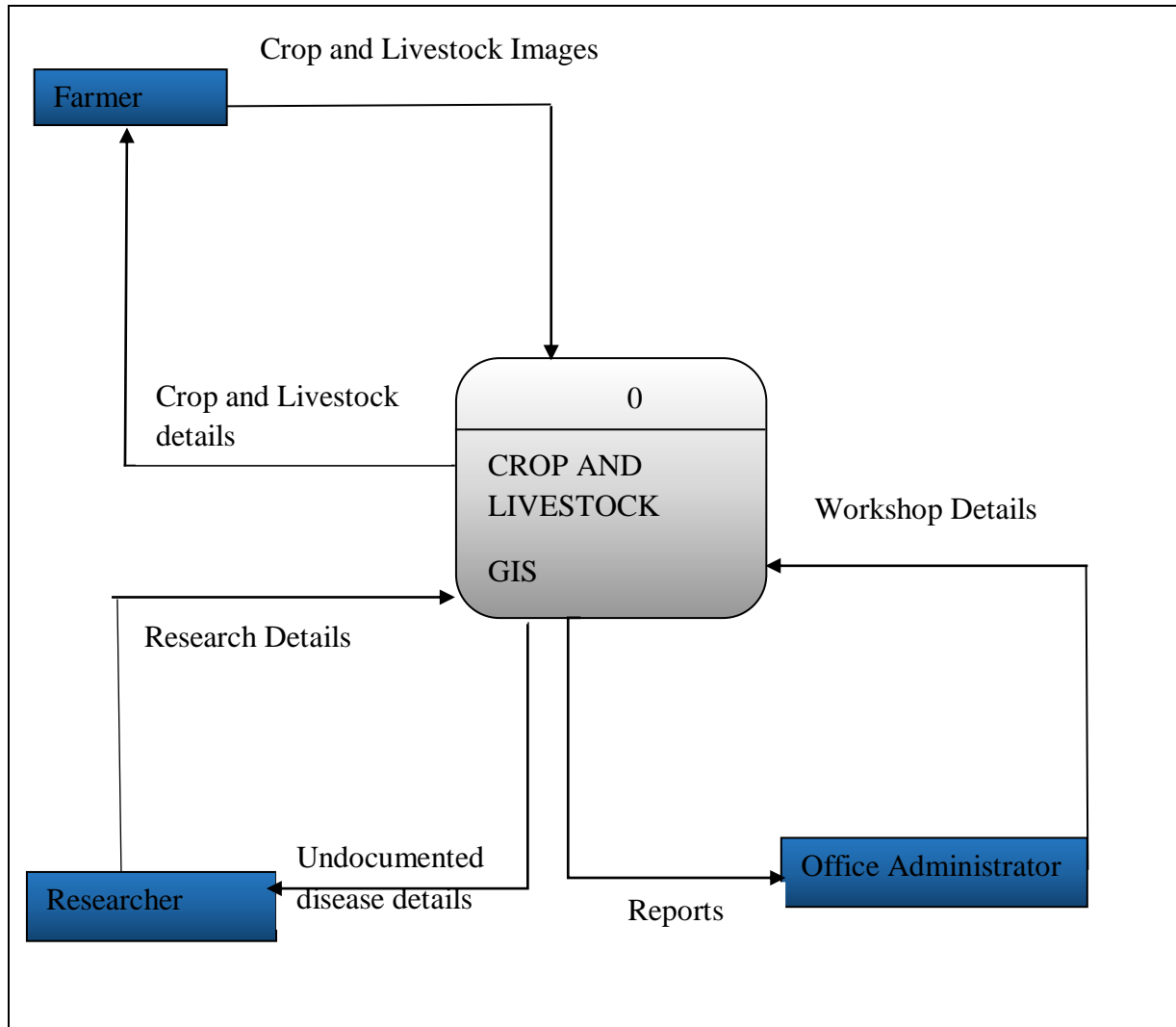

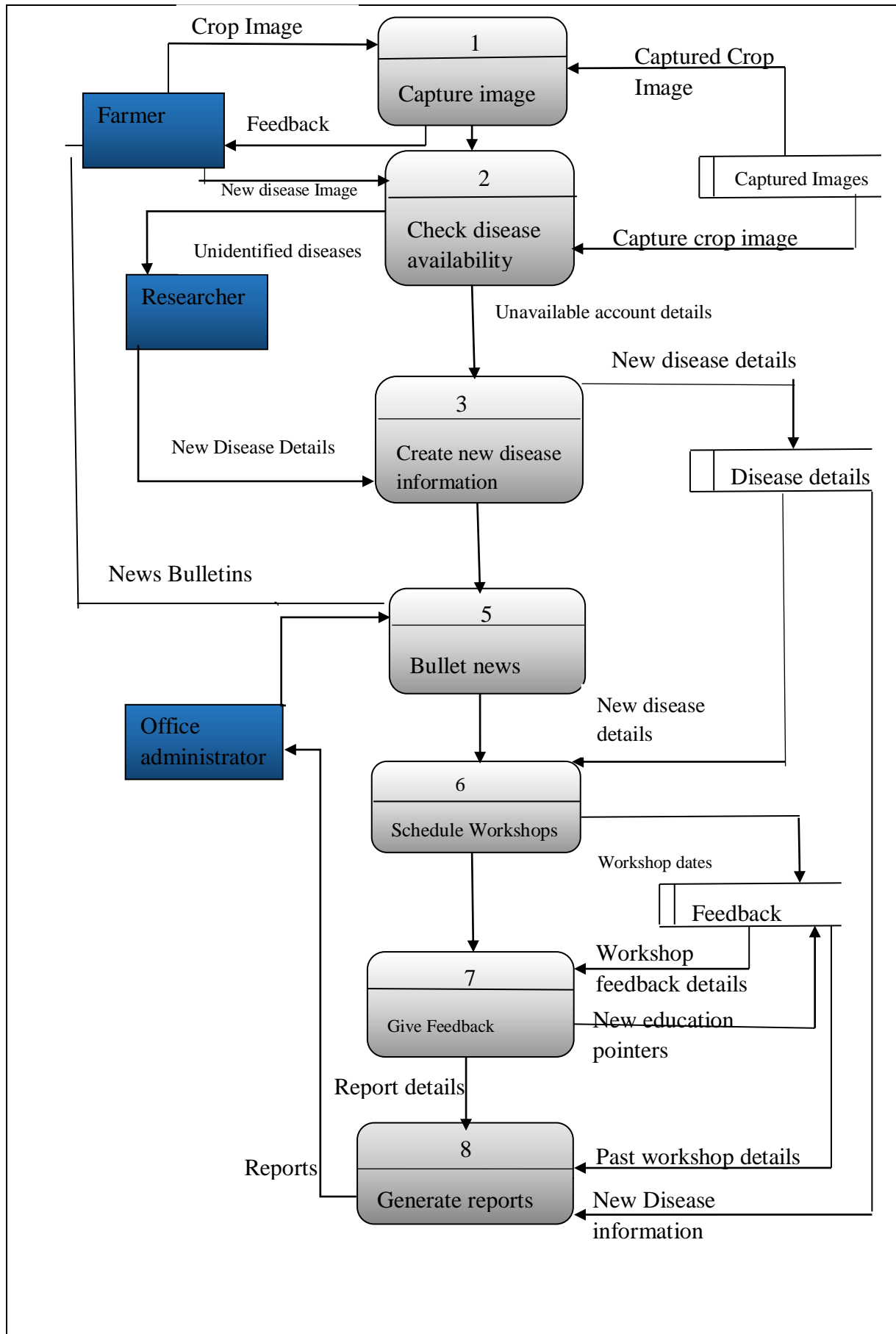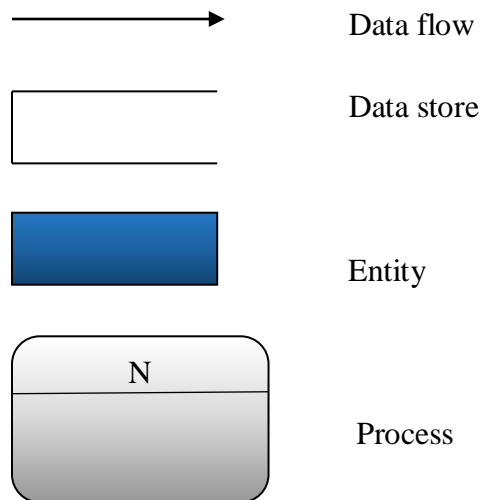**Figure 4.1: Context diagram of proposed system**

Figure 4.2: Data flow diagram of proposed system

Key:

Data flow

Data store

Entity

N

Process

4.3 Physical Design

Architectural design depicts the technical environment where the proposed system will be mounted upon. It shows the physical and logical design of the system which may include the hardware, software, procedures and data as well as the users that will be needed in the usage of the system (Whitten, 2004). The system had to embrace the following:

Hardware

Mobile Phones – this is a mobile user interface of the application which links the farmers to the central database and posting requests of information.

Server – All the data was be populated in the server

Printer – this is used to put on paper any information that will be from the system

Desktop/ Laptop Machines – This accommodates the web interface of the system as well as making updates to the database in the servers.

Switch – it is a central link that distributes internet and other local area network connection that came with the server.

Network cables and Router- this furthers distribute the network

The exact component was detailed with specifications in the following table:

Table 4.1: Hardware Specifications

Hardware	Hardware Specifications
Desktop Computers	Intel Pentium IV processors, 500GB Hard drive
Printers	1320 HP Laser Jet printer, Drivers and interface cables
Network Devices	24 port Trend net Hub, RJ-45 sockets, network cable and 10/100 mbps Ethernet cards
Server	Dell PowerEdge 2950 III Quad Core 16 GB 1TB
Network Cables	Cat6 550 MHz 10Gbps
Router	Netgear Nighthawk AC1750 Smart Dual Band Wi-Fi Router
Switch	Netgear GS105Ev2 24-Port Gigabit Smart Managed Plus

Software Requirements

The following are the software requirements of the system and the purpose they served in the development of the system:

Table 4.2 Software Requirements

Software	Purpose
Microsoft Visual Studio 2015	It is an Integrated Development Environment (IDE) doing the actual development of the system
SQL Server	It is a database management used to perform tasks queried by the database
SQLLite	It is a self-contained transitioning engine that will be doing the database manipulations and communicating with the server.
Android Studio	It is the IDE developing the mobile platform
GPS	It enhances the taking of geo-coordinates
Xamarin Studio	It aided in the development of the mobile platform.
Azure	It helps in application development.

4.4 Architecture Design

This phase embraces how the hardware components was distributed to give the optimum communication with the software requirements. There is a client server network architecture where each computer a client or a server and the database is stored on the server (McGovern, 2004). All the client machines will be accessing the server either remotely or physically depending on the location and the mobile devices will communicate with the server remotely via the internet. There will be two types of connections which are the Local Area Network (LAN) and Remote Access, where the LAN will be used for those client machines that have a close

proximity to the server. Remote access is the ability to access to a computer or computer information from a distance without being physically there (Lawson, 2012). The LAN was set up in a Star Topology which is a LAN arrangement which will have all the nodes connected on a central point like a switch or a hub. It was designed as shown in the following figure. The Remote Access is privileged to those who are far from the server and they will access the server via an IP address. Client Server Architecture balances the processing time between the client machine and the server and has more of the following advantages:

- It supports many types of clients as well as servers
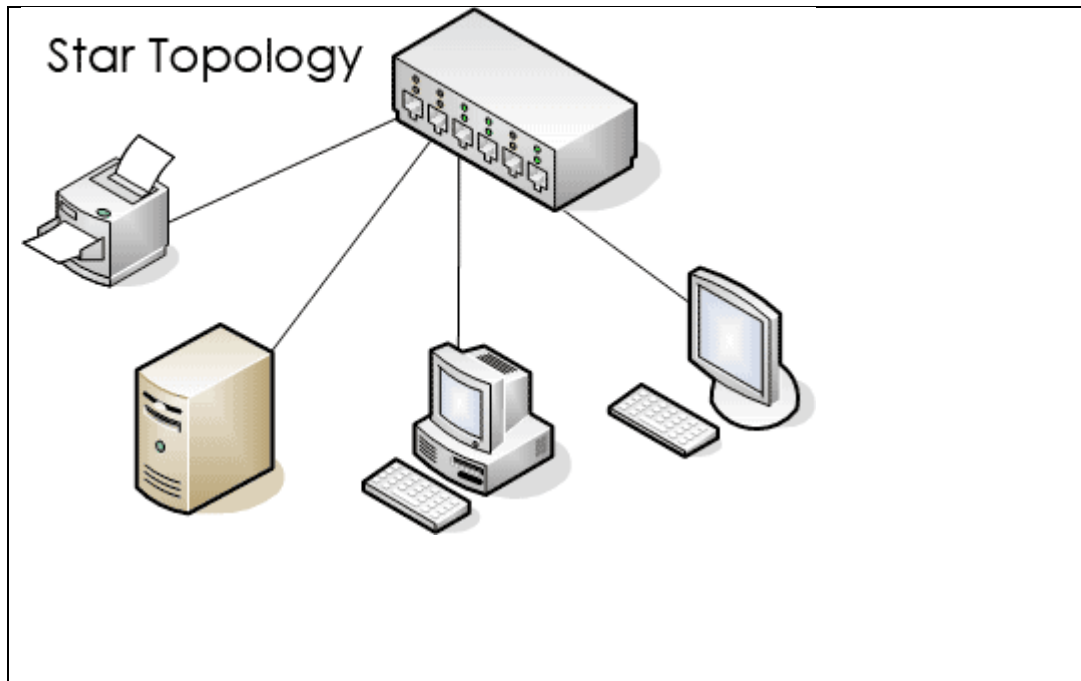- It supports different operating system platforms on the network

 Figure 4.3: Star Topology

Source: *fossbytes.inc*

Figure 4.4: Remote Access

Source: techheads.au.uk

4.5 Database Design

The data collected is being warehoused in an azure relational database which uniquely stores information with tags. The proposed system has a database management system as it defines, manipulates, constructs and maintain the database amongst the user and applications. The system user information was designed using SQL Server as the database Management System. This choice was made over the file based system because of:

- Integration of files was easy and normalisation is effected to reduce data redundancy
- There was improved security by the use of passwords and access levels
- There was incorporation of data in one central database hence reducing costs
- There was backup and recovery facilities
- There was room for concurrency and a well effected concurrency control algorithm
- There was data consistency since data will be validated upon entry

The design of the database was represented in a physical and logical form:

4.5.1 Physical Database Design

This is the actual architecture of the database identifying the schemas in the system. The design describes the arrangement of data in the database in the form of schemas or layers. In the database, there is the physical, conceptual and application layers as shown in the following:
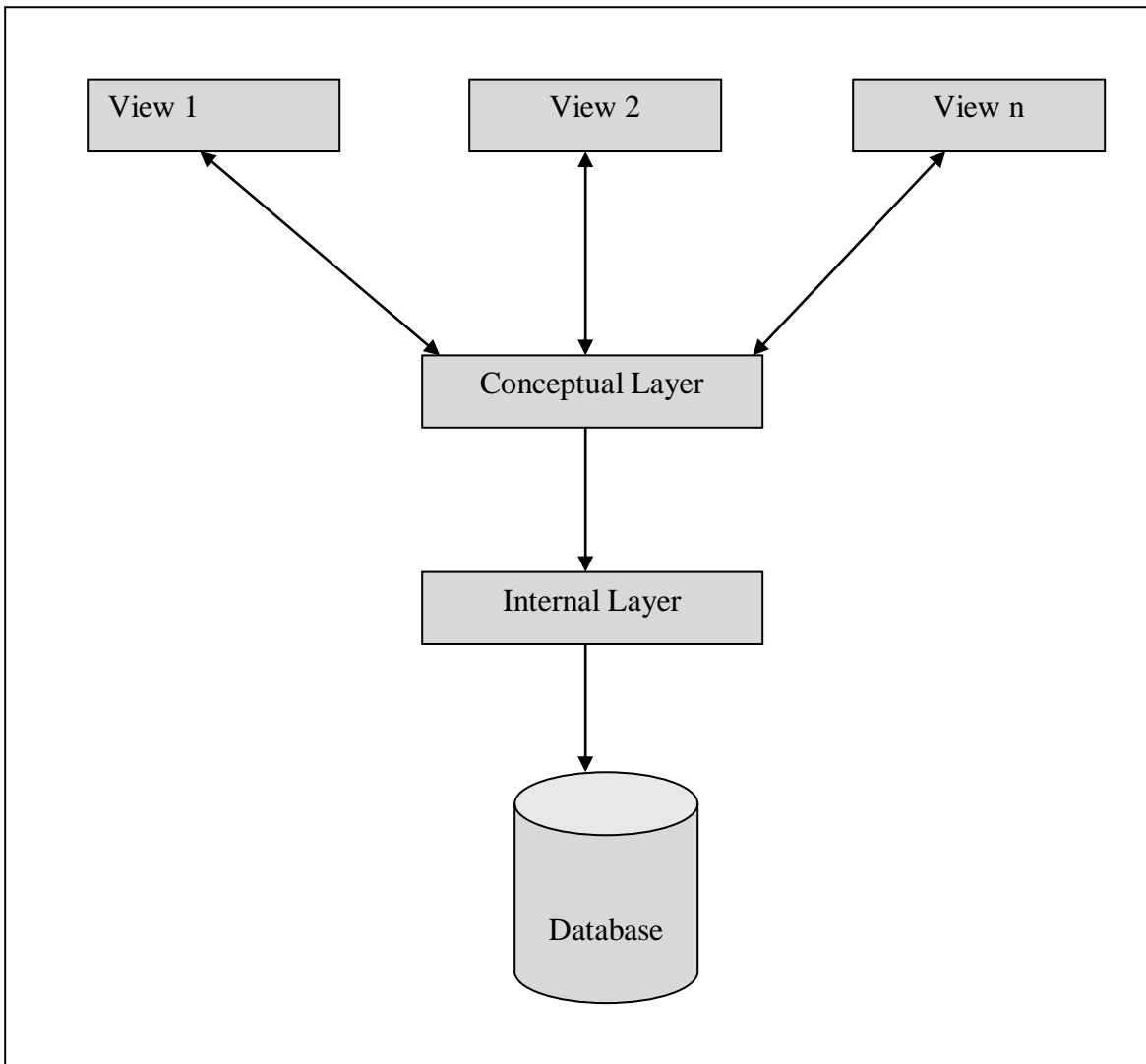

Figure 4.5: Database Architecture Layers

Source: SlidePlayer.com.inc

a) Physical Layer

This is the actual location where the data will be stored.

b) Conceptual Layer

In this level, data is stored in the database and collaborated with the relationships that the data has. The data is stored in tables which were validated by the design to ensure what the database stores in that particular table. The table attributes and data types standardises data being stored and attributes include integers and strings. This was where queries were also defined to know how the data can be retrieved

c) Application Layer/View Level

This is abstraction at its highest level. It simplifies the user interaction with the database thus the user can manipulate the data. There is also viewing processed data in form of reports and grid views, Manipulation at the user's end is done by SQL. Tables have either one to many or many to many relationships. The following is a normalised schema of a sample table in the database. The field name is the attribute name, the data type means the type of the characters for example string or long. With the data type it will check the maximum characters accepted on that field.

Table 4.3 User Table

Field Name	Data Type
Username	VarChar (50)
Password	VarChar (50)
Access Level	Int (10)

4.5.1 Logical Database Design

This is the identification of the entities in the system and how they relate to each other. This will be done using an entity relationship diagram and an enhanced entity relationship diagram.

4.5.1.1 Database Tables

The following are the database tables that came with the system.

Table 4.4: Database Design Tables

| TABLE NAME	FIELD NAME	Data type	Description
Administrator	**ID**	GUID	An unique identifier of administrator
	FIRSTNAME	Varchar (20)	Administrator's first name
	LASTNAME	Varchar (20)	Last name of the administrator
	USERNAME	Varchar (20)	The name the administrator will be using in the system in form of email address
	USERTYEPE	Varchar (20)	The work rank the user has
RESEARCHER	**ID**	GUID	Sequential number of a patient
	FIRSTNAME	Varchar (20)	Researcher's first name
	LASTNAME	Varchar (20)	Researcher's last name
	DOB	Datetime (10)	Researcher's date of birth
	EXPEREIENCE	Double (12)	Researcher's years of experience
	EMPLOYEETYPE	Varchar (20)	The department being worked for
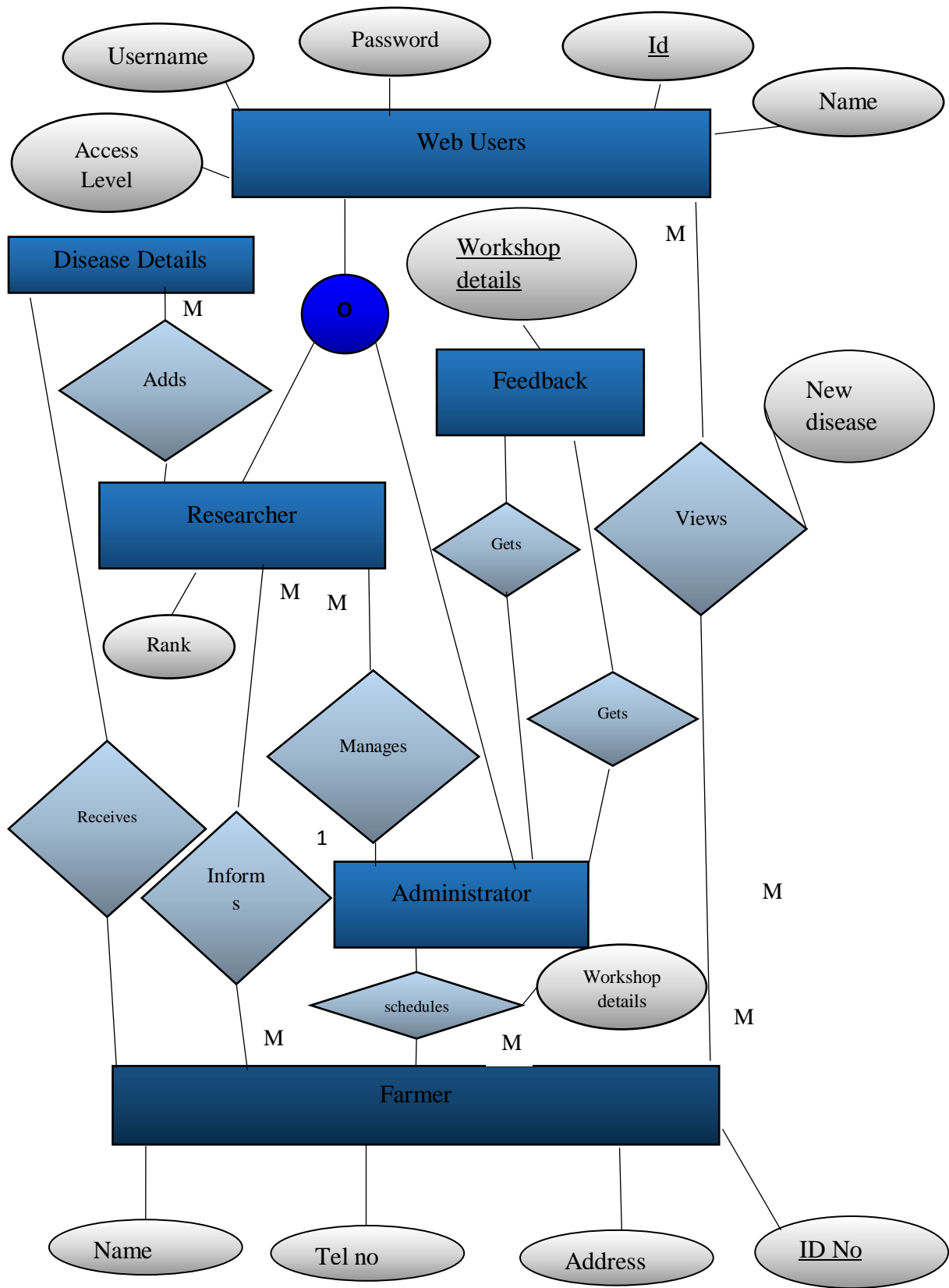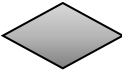
Figure 4.6: Enhanced Entity Relationship Diagram

	Entity
	Super-type sub-type discriminator
	Attribute
	Relationship

4.6 Program Design

In this phase there is the actual augmentation of modules functions and classes of the proposed system. The design methodology will break down the system into subsystem and further into modules. This will be represented into:

- Package diagram
- Class diagram
- Collaboration diagram

4.6.1 Package Diagram

This shows the dependencies between packages. It helps see views using different angles on the tier basis (Ambler, 2005). The following represents the packages of the system:

Figure 4.7: Package Diagram

Key:

Package

Generalisation

4.6.2 Class Diagram

This is a static structure diagram describing the system structure, showing their classes and attributes as well as operations and 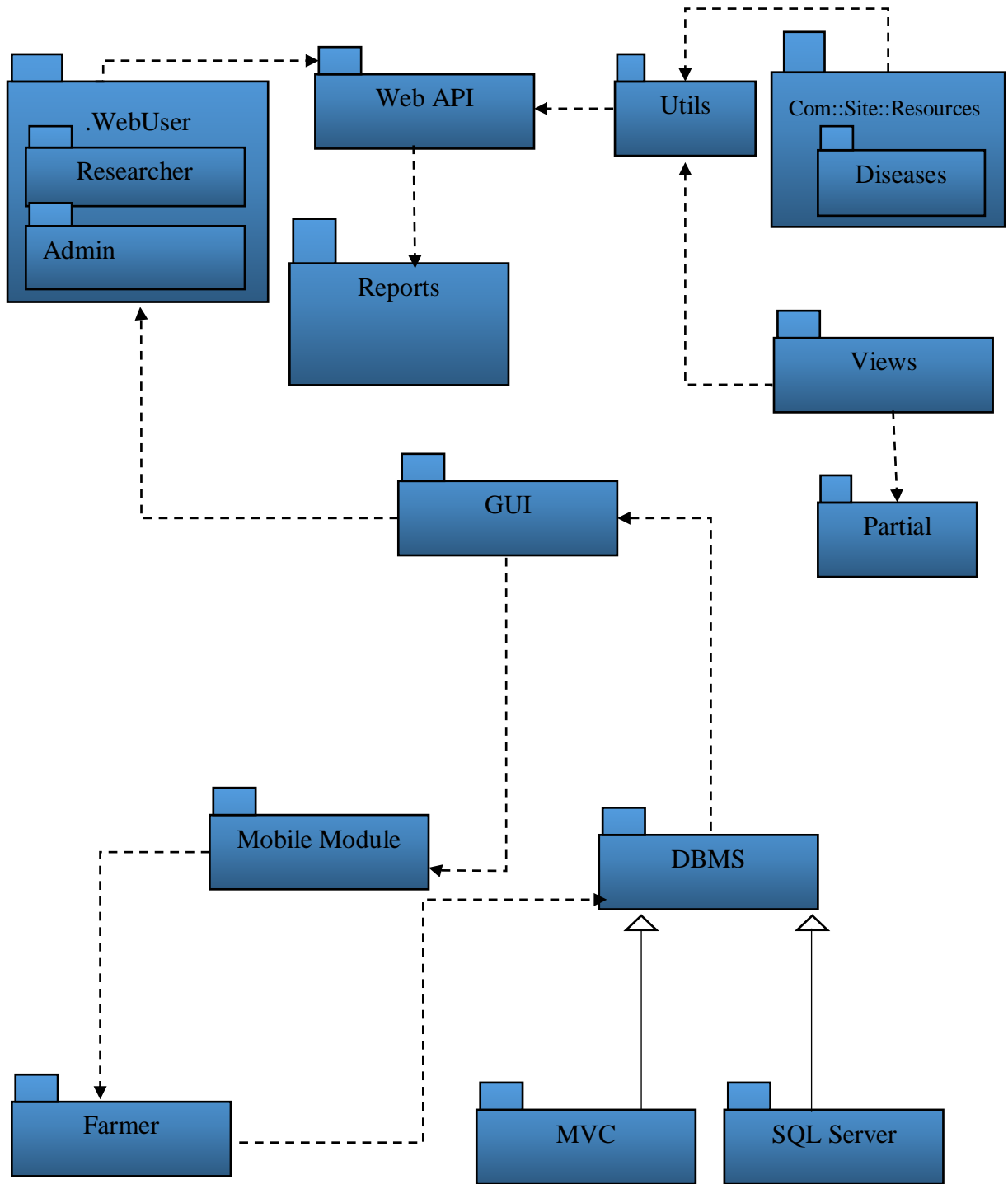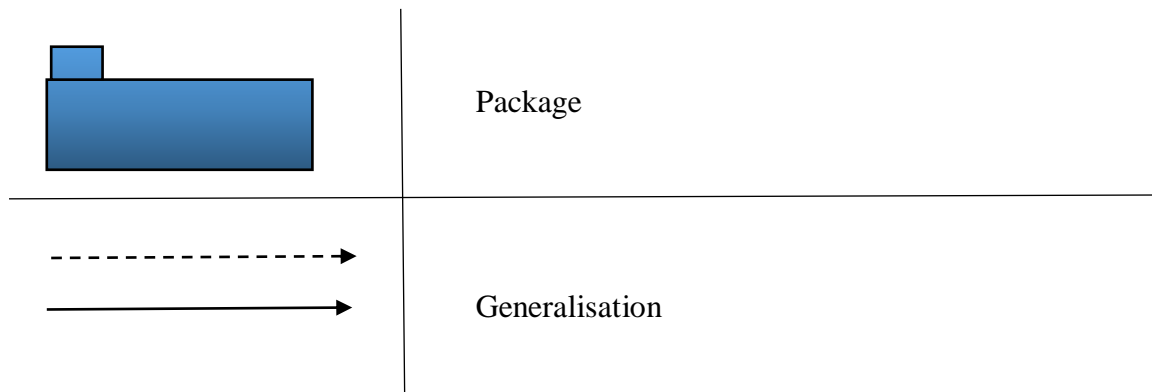relationships conjoined (Terry, 2000). The proposed system has the farmer, the stakeholders and administrator as some of the main classes as represented in the following:
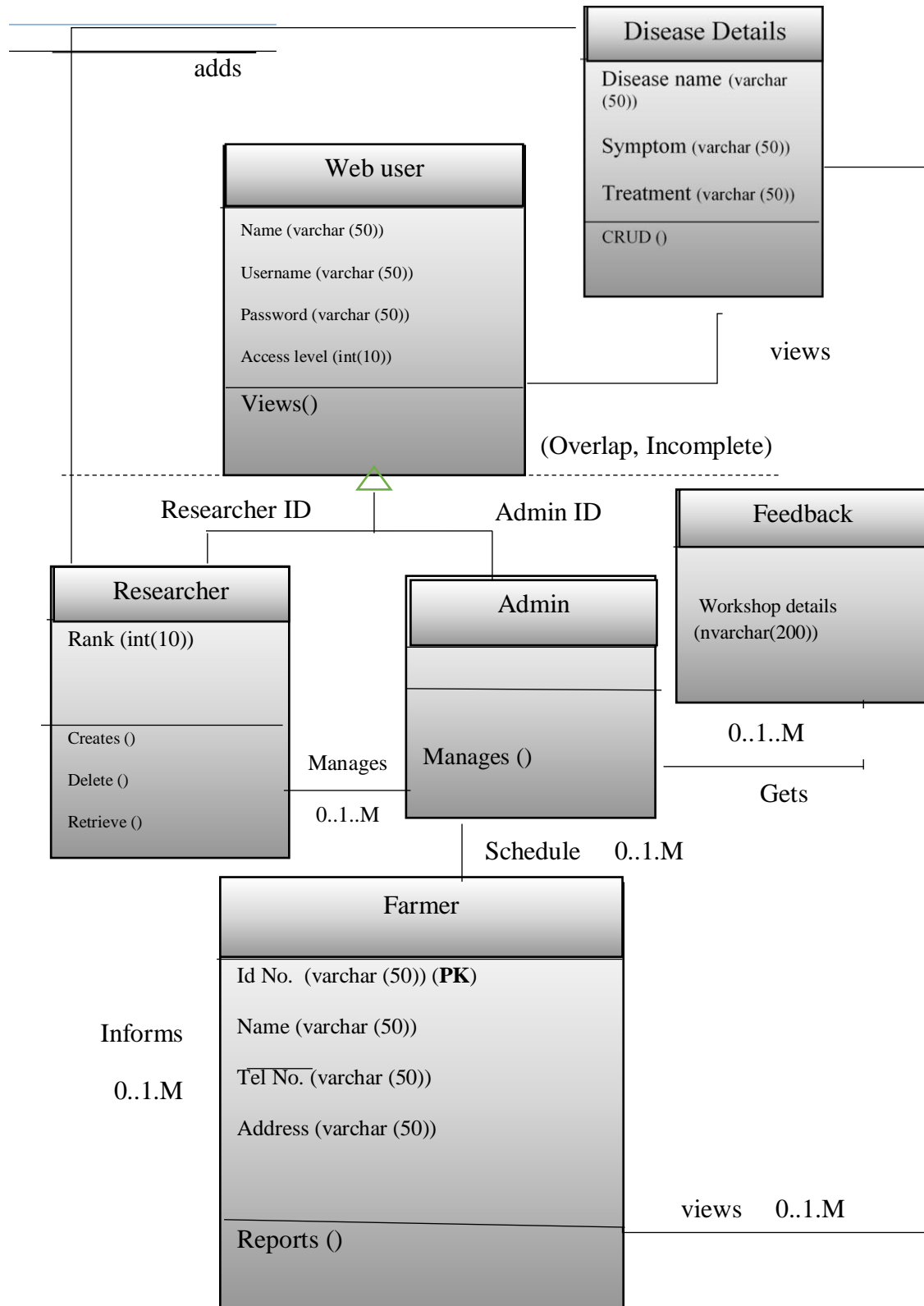
Figure 4.9: Class Diagram

4.6.3 Sequence Diagram

This is an interaction structure which emphasizes on the organisation of and the relationships that are amongst objects. They show different views from each perspective (B'far, 2004). The proposed system will have the following collaborations:
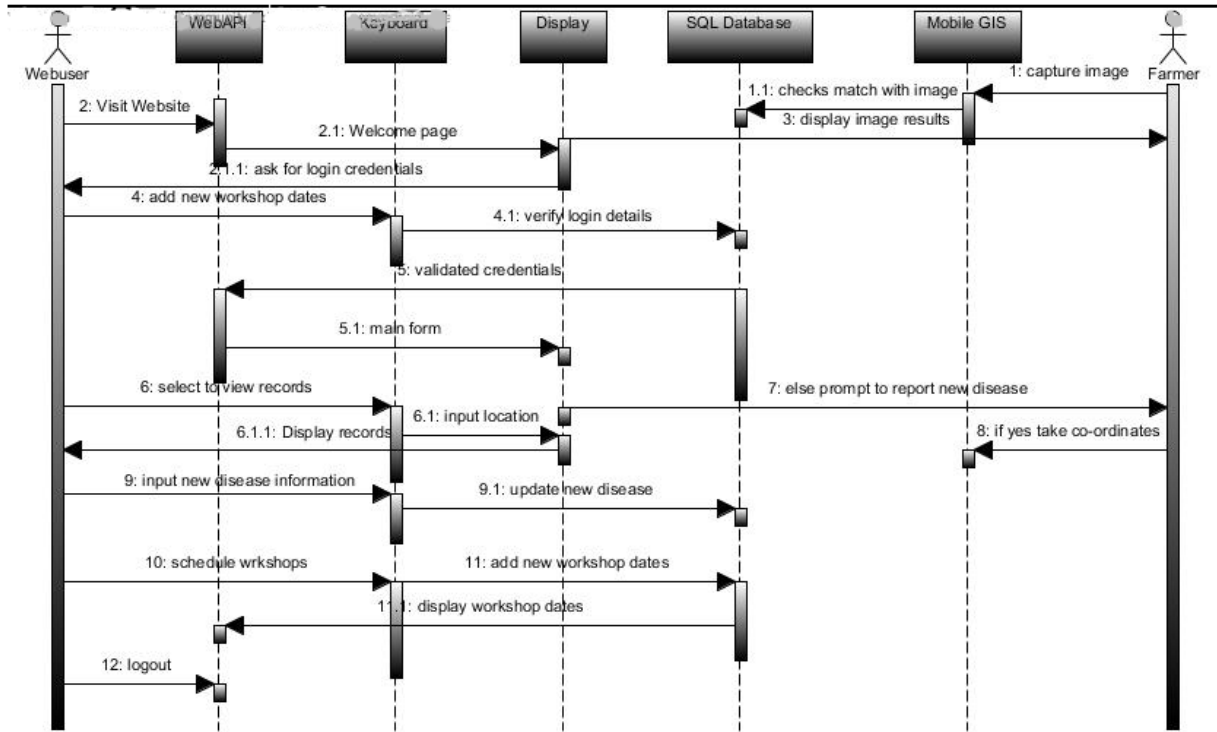
Figure 4.10 Sequence diagram

4.7 Interface Design

This was designed to handle all the interactions platform as viewed by the user also known as the graphical user interface. The Interface of the system is definitely user friendly with little to no complexity. It acts as a display tool to communicate between the user and low level tiers of the system which included the database. There is a mobile interface for the farmers and a web based user interface for the other stakeholders. The web based interface is able to communicate to the server retrieving information from the central database. The following are the main forms that are in the system:

a) Login Form

This form authenticates the users that will be given access in the system. Depending on the access levels it will give you either entire or partial access to all the facets of the system.

Login Form		
Username		
Password		
	Login	Cancel
Password Recovery		

Figure 4.11: Login form

Forgot Password form

This form helps retrieve password to any user who would have lost their credentials to the system. This form is shown after the user have clicked the Password Recovery text in the login form. The form will be as follows:

Forgot Password Form	
Email	[_____]
New Password	[_____]
Repeat Password	[_____]
	Done **Cancel**

Figure 4.12: Forgot Password Form

b) New Research Form

The form makes the researcher able to register new pest and diseases that are new to the database. It even manages to make manipulations in the database which will update the information in the database. The following displays the diagrammatic interface of the form:

New Research Form	
Disease Name	[_____]
Disease Details	[_____]
Method of Treatment	[_____]
	Done **Cancel**

Figure 4.13: New Research Form

c) Pest and Disease Form

In this form the farmer will put the image of the pest and or disease so that it can be scanned and information may be retrieved from it. This form will be on the farmer's mobile phone .It will be as shown in the following diagram:

Capture Image
Cancel

Figure 4.14: Pest and Disease Form

4.8 Output Design

The proposed system also provides users information that the users may need. The farmer after inputting the imagery of the pest they will retrieve the information and it will be shown in a summary with headings and details under the headings. Reports are done by the system which will be represented spatially as well as in grid form. Information that can be printed to hard copy in a summary reports. The following shows both the mobile user retrieval form and the reporting form:

4.9 Pseudo Code

This is a way of simplifying programming code. It can be written in actual English. It gives the knowhow of how the program is functioning and it creates statements that will satisfy the required results (Morin, 2013). The following is some of the pseudo code showing how some functionalities were to be undertaken.

Procedure on Login

Open Page Window

Prompt User to enter credentials

If input is null

Then display ("Please Enter username and Password")

If user input is NOT equal to username && password

Then display ("Please Enter Correct Credentials")

Else Login

Display Main Form

Procedure on New Disease

Start Mobile Application

Scan Image

If scanned image is NOT equal to Database disease

Then display ("Disease not found. Do you want to report new Disease?")

If Response == yes

Then get coordinates

End

4.10 Security Design

This is the architecture of how unwanted or unauthorised entries can be mitigated. Standards or precautions were set to ensure less risk of either security breaches or loss of information (Wheeler, 2011). The system look at the following security design:

4.10.1 Physical Security Design

The server ensures security is housed in a room that can be locked and the keys will be managed by the administrator and a request to visit the server form shall be filled when needed.

4.10.2 Network Security Design

The network barriers to unauthorized entry is enhancing by use of firewalls and passwords on the network connection (Convery, 2004). Moreover, the antivirus installed also has a firewall to help advance the network security.

4.10.3 Operational Security Design

This is safeguarding the day to day operations, manage sensitive information and maintenance of secrecy when needed (Guidspot.inc, 2017). In this system this is ensured by the use of passwords on the system and access levels as well as backup of a certain interval of time.

4.10.4 Database Security Design

Since the database is the central warehouse of all the system data it will need a password and level access rights as administrator, where it will filter what each authorized users will view and well as manipulation rights (Thuraisingham, 2007). This will restrict access to unauthorized users.

4.10.5 Software Security Design

The Web based API authorized user access. There is now access levels which the system is privileged pertaining manipulation and viewing. Client machines have an antivirus to protect software and the firewall.

4.11 Conclusion

This phase has focused on the design phase of the system, clearly pointing the systems design as well as the architectural design, the physical design and the database design. It also looked at the program design showing the sequence diagram and the class diagrams. There after it explained the interface design giving a bit of pseudo code as well as the security design of the system.

From this phase there was the implementation phase where there would be testing, installations and maintenance as well as the recommendations that the system requires if any.

CHAPTER FIVE: IMPLEMENTATION PHASE

5.1 Introduction

The implementation stage where there is the actual code of the system that is implemented after the design phase. The software system went under several testing to confirm if there are any errors. These tests were done before the system was installed to the user and the steps are iterated until the system passed all the tests. Thereafter, the system was deployed and installed on the internet. Training was done as well as maintenance and recommendations for future use. All in all, this phase looked at the implementation plan and how to effect maximum system exploitation. There are details of various changeover plans and all types of testing before the system is installed.

5.2 Coding

Coding is writing commands that will help interact with the system in a programming language as C# or Java (codeconquest.inc, 2017). Design was done using Microsoft Visual Studio and SQL server with SQLite as the database management of the system. Microsoft Visual Studio was used to develop the graphic user interface with ASP.Net. The intelligent algorithm was done with Azure. The system was modularized based on the procedures as regarded by object oriented programming. The modules were then assembled into one application. The SQL Server Database Management was used to link the program to the database. SQLite was used for the same connection only on the mobile version of the system. The database manager was responsible of query execution such the SELECT, INSERT and DELETE as well as managing views.

5.3 Testing

System testing is the process of verifying the integrated system modules to see if it is performing as per requirements (softwaretestingfundamentals.inc, 2017). Testing for the crop information system was done using the following techniques:

- Unit testing
- System testing
- Acceptance testing
- Module testing

5.3.1 Unit Testing

This refers to the testing of a specific and directed part of code normally code on a functional level. Components were tested individually and independently to verify whether there any errors may happen. These errors include runtime errors which may happen when the system is in operation (softwarequality.inc, 2017). Two techniques are used for this type of testing which include:

- **Black box Testing**

  This is a testing of the system interior components versus the output that it produces when a condition has been parsed. It tests the absence of functional requirements in relation to the objectives that would have been imposed (Valacich, 2012).

  a) **Advantages**
  - It puts into consideration the actual user than the programmer
  - The test is unbiased since the results will prove the condition that would have been entered

  b) **Disadvantages**
  - It is very vague that not all tests will be considered in the testing
  - As it is vague, it is also difficult to confirm which type of test was being in to consideration.

The system underwent black box testing.

- **White box testing**

  This is testing of the internal operations of the program. This type of testing goes deeper with detail on identifying errors not revealed by the black box testing method (softwarequality.inc, 2017).

  a) **Advantages**
  - It is precise since a test will be focused on the functionality being tested

  b) **Disadvantages**
  - The one testing must be well vexed with programming to be able to perform such test.

- **Defect testing**

Under this testing, there is irregularities discovery within the system. It opened up the system errors before the system is deployed (softwarequality.inc, 2017). The following diagram shows defect testing process:
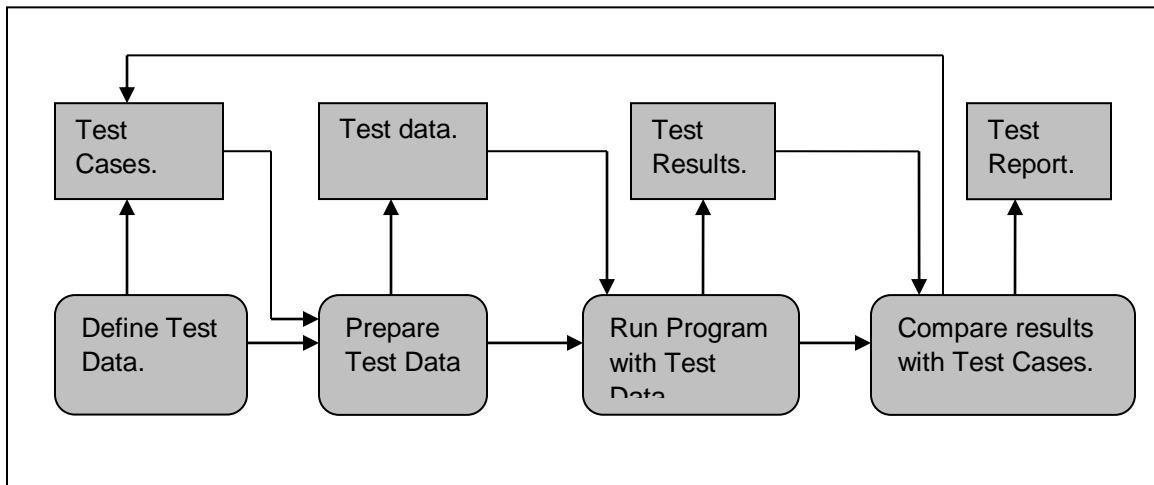

Figure 5.1: Defect Testing

Source: softwaretestinghelp.inc

From the diagram:

- **Test Data:** This is input that has been inserted into the system to confirm if the system will compile relevant reports in the system
- **Test Cases:** These are input and output specifications of the module that is being tested
- **Test Results:** These are the outcomes that come out when each modules have been run. They are then summed to give a big picture of if the system is functioning well
- **Test Report:** This is now the summarized on the system as a whole to confirm if it meets user requirements

5.3.2 Module Testing

This is the collection of component that depended on each other for functionality, for example a package or collection of functions and or inherent procedures (softwarequality.inc, 2017). This

was done to confirm if the system has removed records from a database where results are of paramount importance. The following, testing of files of bigger that megabytes was posed as an example for module testing, the module

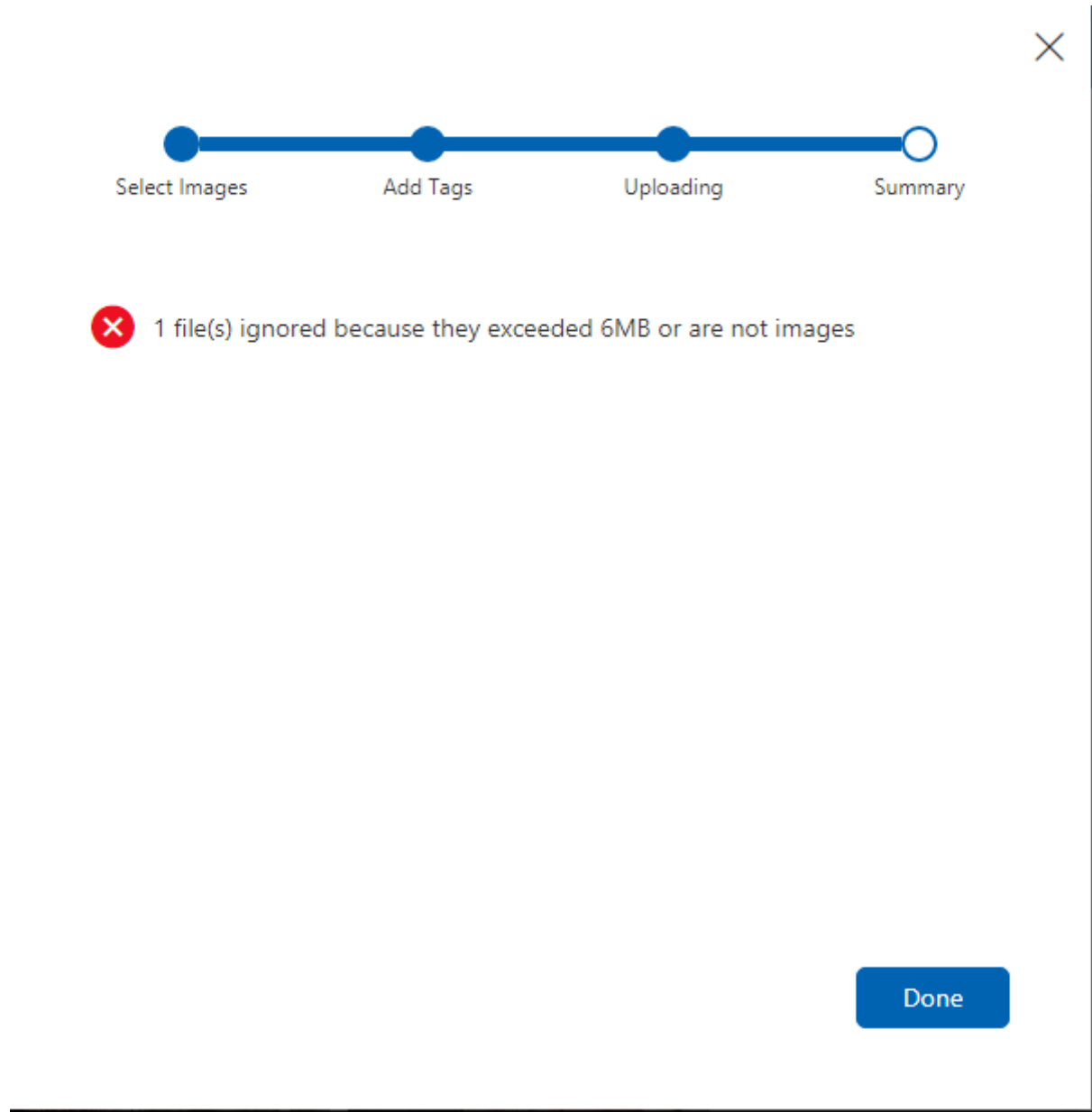**Figure 5.2: Big file size error**

5.3.3 System Testing

System testing refers to a series of tests whose paramount responsibility is to exercise the computer based system. The tests include recovery tests stress tests, security tests and

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performance test (softwarequality.inc, 2017).The system at hand was deployed on a n executable file and tested to confirm if it was performing as per required satisfaction and also checking its functionality. The tests were successful since it could retrieve records from the database and do all create, update, retrieve and delete functions from the database.

Objectives vs. solutions

This tested system functionality with an epitome of the proposed objectives. This type of testing was done to ensure if the problems initially passed have been mitigated. The comparison was done as shown:

Objective: To train the system to increase precision
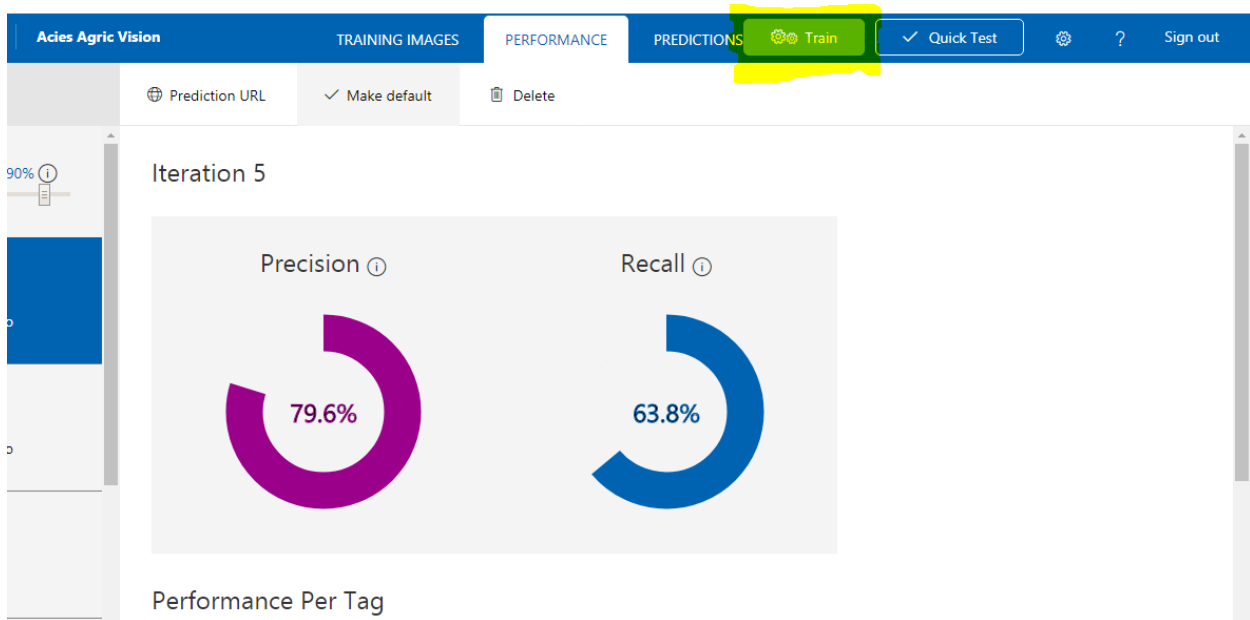
Figure 5.3: Training the system

Objective: To compare the disease with the diseases in the database with a 90% precision return.

Solution: The system has been designed to a closer to no user input. The Farmer will only take a button from the crop disease and the system will check for the disease on its own. If the disease is unavailable the user is prompted to report a possible new disease in the

database that will notify directly the administrators and research on that disease is done as follows:

Tag	Probability
Downy Mildew	0 %
Fusarium	0 %
Anthracnose	0 %

Figure 5.4: Comparison Results
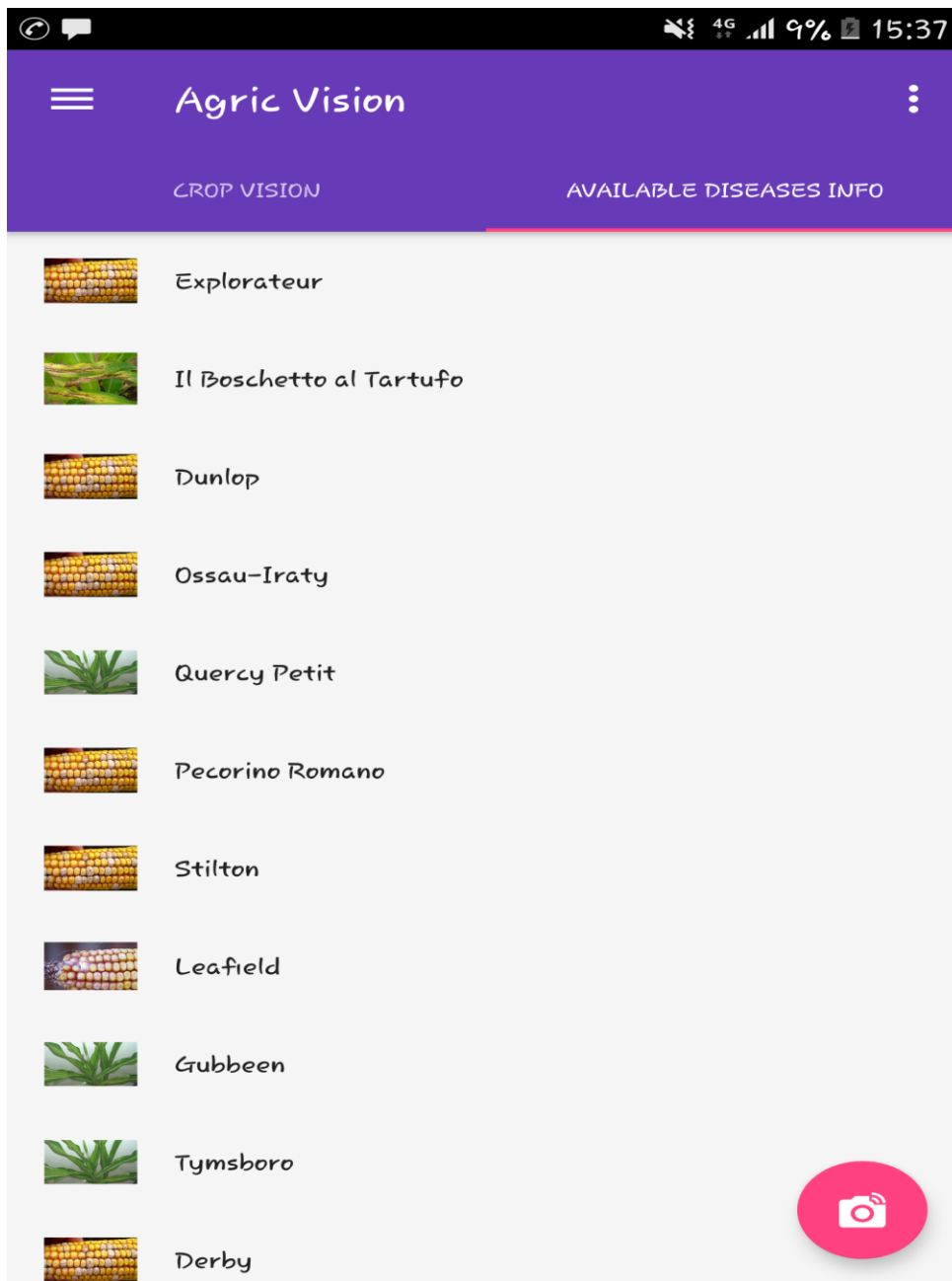
Figure 5.5: Display of available disease which the user will refer to.

Objective: To measure the system reliability via performance tests

Solution: The system will calculate the total number of test images and expresses it in terms of an average of the precise images that satisfy the system requirements. The system will pronounce to you in terms of a pie chart of how reliable a test is using the precision and recall charts.

Figure 5. 6: Performance Test Results

Objective: To group all untagged data for the web users of untrained images

Solution: The web platform will save all untagged images that help the researcher to update the database quickly. This will tag a summary in the predictions tab of the system.

Figure 5.7 : Untagged image in the system.

Objective: To self-learn from its mistakes, helping in disease precision

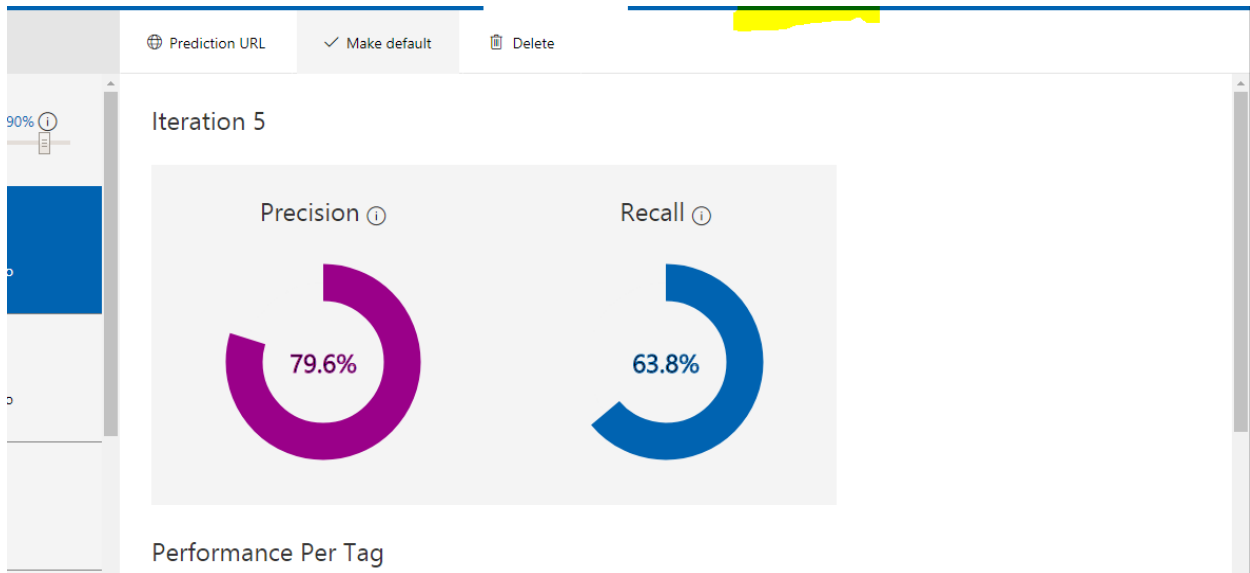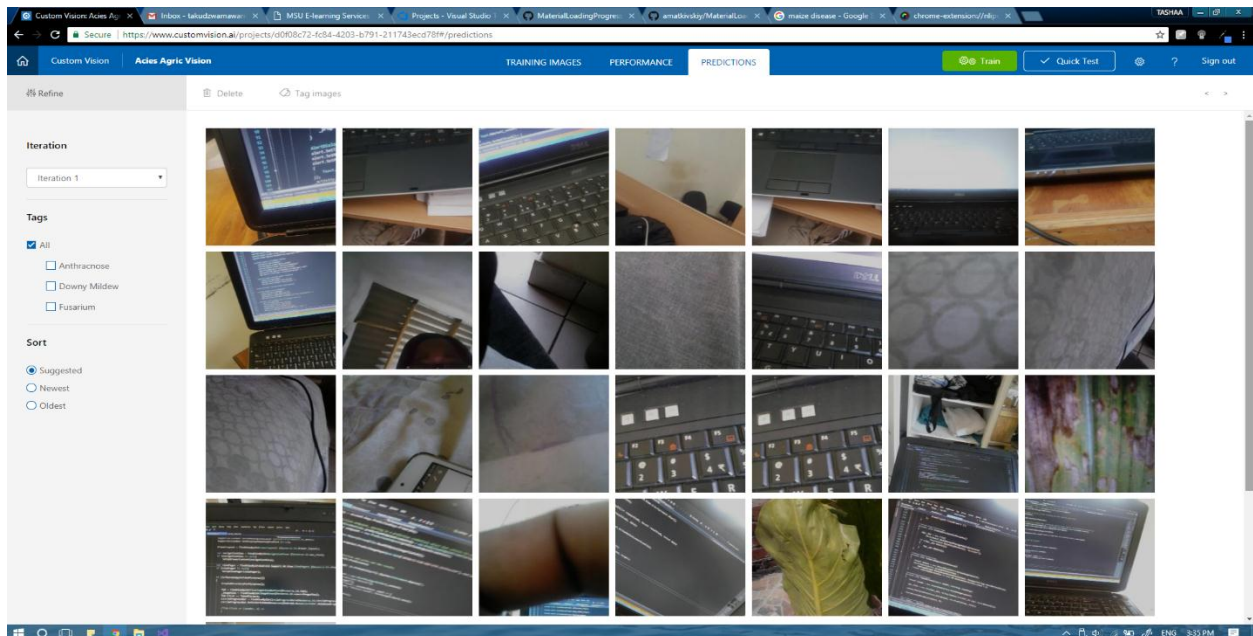**Solution: The system has an algorithm that enables it to learn from its past experience. This entells the system has the ability to help the trainer make better on the tags to put on that image.**
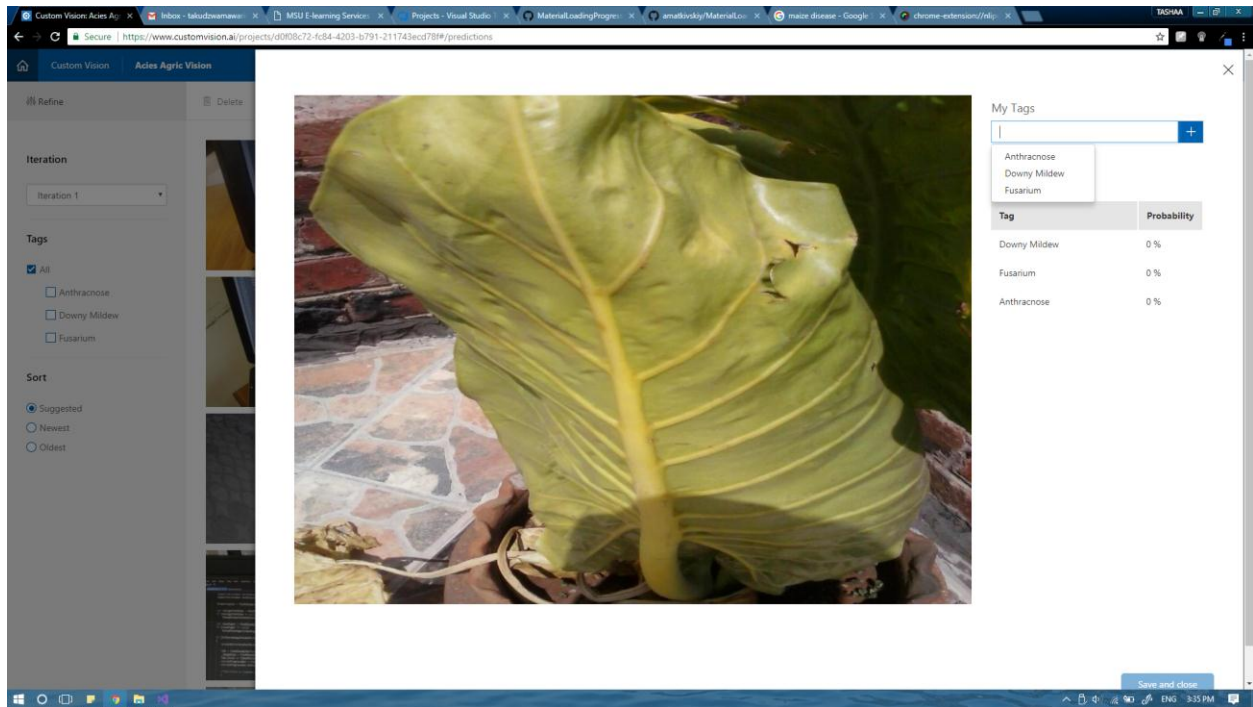
Figure 5.8 : Suggestive prediction to tag training images.

5.3.5 Verification and Validation

The system had to go under validation and verification processes.

5.3.5.1 Validation

System validation tends to answer the question, "Is this the **RIGHT** software?" Validation is the evaluation of software system to determine whether the components of the product satisfy the conditions put into consideration (ieee.inc, 2017). It was carried out to determine if the augmented system is conforming to the specific user requirements. As posed in system testing, there needed insurance of the system meeting the expectations of the users. This process also aided in informing or notifying the user if the input entered is the right data format that is required by the system. Specific tests are exercised which include the following:

- **Regression Testing**- Here was performed on the system to ensure if the features of the system are working. This is done by comparing the system functions of the older system versus the functions of the new system (guru99.inc, 2017).

- **Recovery Testing** – the system is crashed on purpose to confirm if records that had been entered are lost. This benchmark the system performance with the previous methods of saving data (tutorialspoint.edu, 2017).

To ensure that the image is of a file type is acceptable, the system itself filter the image types as follows:

If the file size is bigger than the required the system the system airs an error written as follows.

The system does not allow the same disease tags on one training image.
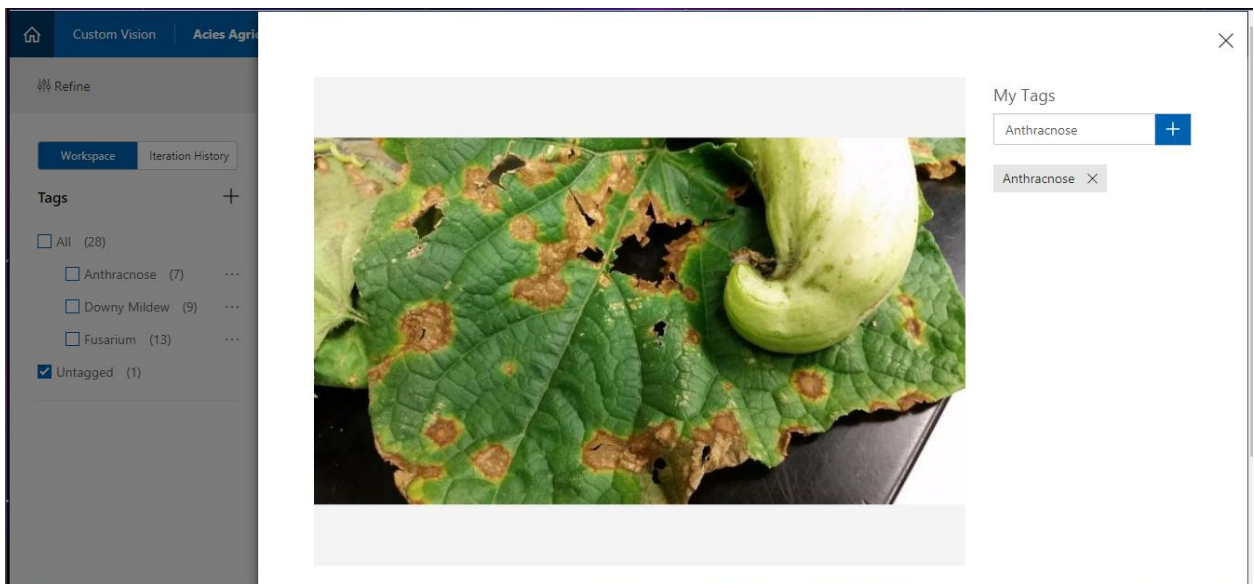
Figure 5.9: Same Tag example

When there is a same tag, the system will not allow to enter it on the tags, it does not add the tag.

The system is intelligent enough to help the researcher confirm the precision of tags on images, thus helping the researcher to filter information to be precise. The previous Iterations will help the system make precision to the images that may come later. This is shown by a percentile on the image tags shown as follows.
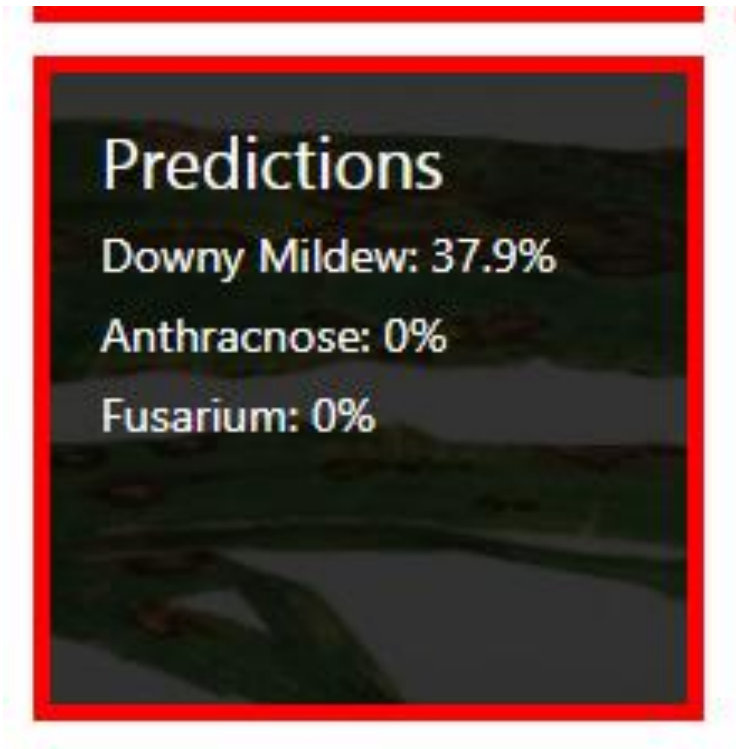
Figure 5.10: Image Summary confirming precision

- **Security Testing -**This ensured that there is no unauthorised entry by any party. It included attempting to illegally acquire information to obtain information and or sending in threats to harm the system. This substantially rebates the fact that the system will remain strongly functional and not allow unauthorised access (owasp.com, 2017). For instance if there is unauthorised access on the web and a web user fill in the wrong credentials, the system does not log in instead reflects an error to tell the user the username and password do not match. The system is highly secure since it uses Microsoft authentication. The following are how the system will validate a user:

- **Stress Testing –** Here abnormal requests were made to increase the rate at which it is asked to accept information. This can also be termed as the rate at which information is required to be produced by the system. This helps to realize the system's strength after use by a large number of users. Since this is an Internet requiring application, if the system runs to a time out it will show an error as follows:

Figure 5.11: System Timeout

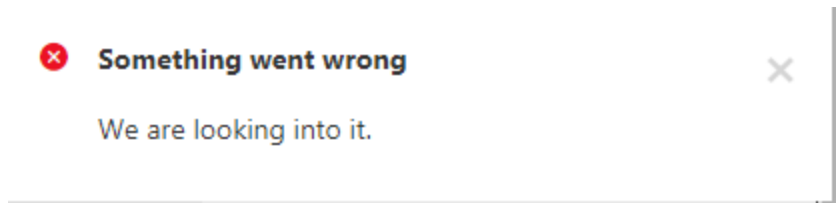- **Performance Testing-** This tested the robustness of the system, checking if the memory size accommodate a lot of user activity. It is checking the main memory, buffer memory and other secondary memories to confirm its response time (tutorialspoint.edu, 2017).

- **Usability Testing-** Under this testing there was checking if the system user friendly. The test was achieved by developing prototype that will require the system user to have a feel and confirm if they can use the system without much hassle (guru99.inc, 2017).

- **Alpha and Beta Testing-** Here end users were given a real feel of the actual system. This is sampled to a smaller cell of users who in turn give feedback to the production team on what they require changed. Once the users were satisfied with this type of test then the real system was deployed to all users (guru99.inc, 2017).

As said earlier, the system uses Microsoft authentication since it is hosted by Azure. The following are the validation testing that were handled by the system on inputting data:

a) **User credential input validation**

Upon registering there are certain characters required by the system when inputting a password. A password must contain special characters as asterisks and periods, at least one number and uppercase letters for it to be deemed an acceptably strong password. The username is in an email format. If the users does not put full characters required on the username and password it will not log in and flags the following:
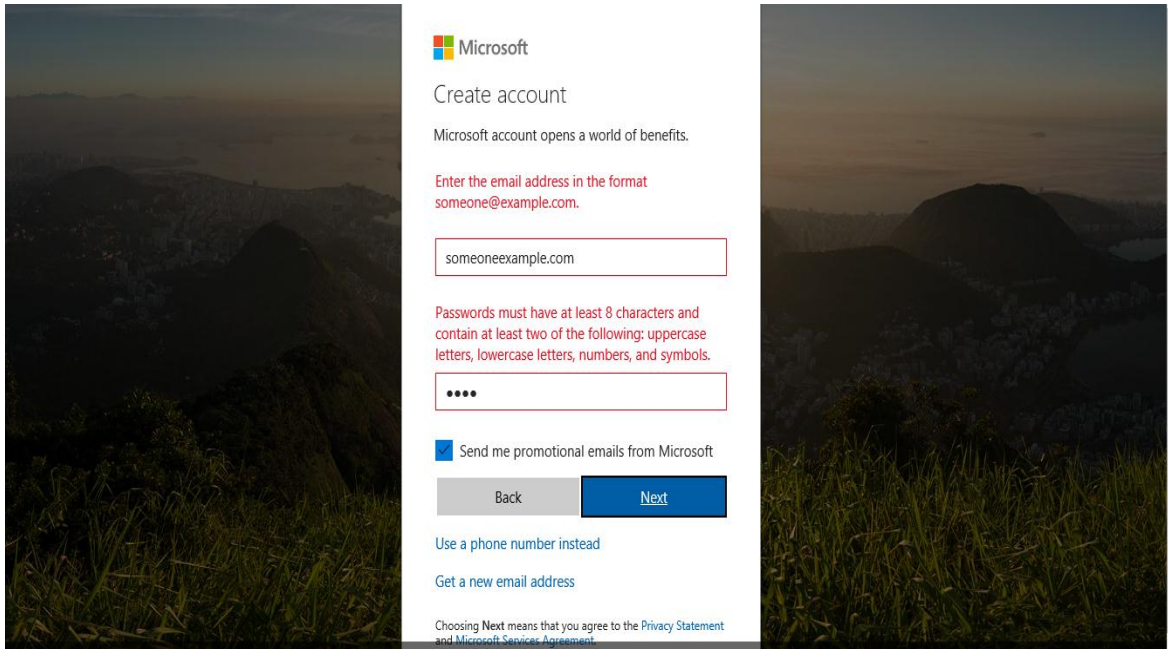
Figure 5.12: User credentials input Validation

b) **Null input validation**

   When the user just presses enter without filling in details, the system will flag errors as shown in the following figure:

Figure 5.13: Null values on signing in

5.3.5.2 Verification

Verification is now the process of evaluating the system shaping whether the product satisfy the conditions imposed (istqbExamCertification.inc, 2017).This was carried out to figure out if the specifications were well met. There was confirming if the system components were properly functioning. It was done using test data and comparing the results with what was expected from the system.

5.3.6 System Security

This poses as one of the most important part of testing. To ensure a high capacitate authentication the system was hosted in azure with a Microsoft authentication which is a globally recognized authentication and amount to subscription to be privileged to these facilities. This was testing the security governing the system from possible threats and under it there are:

a) If a user does not enter the correct username, an error will flag the following error:

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Figure 5.14: Wrong username input

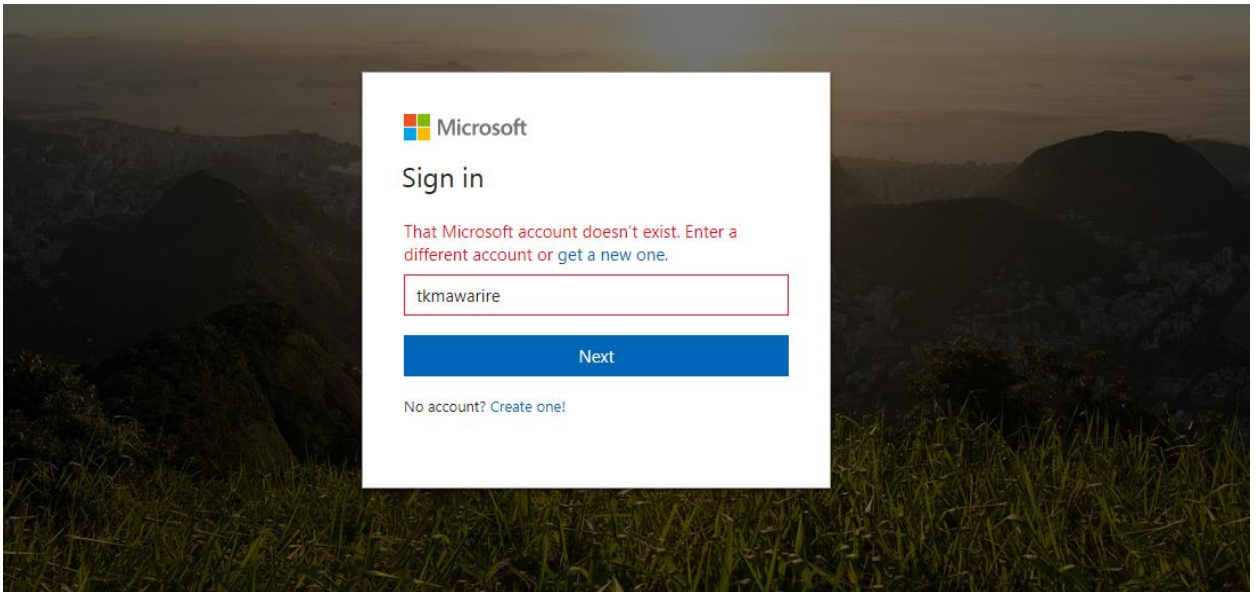b) If a user does not input the correct password the system will flag
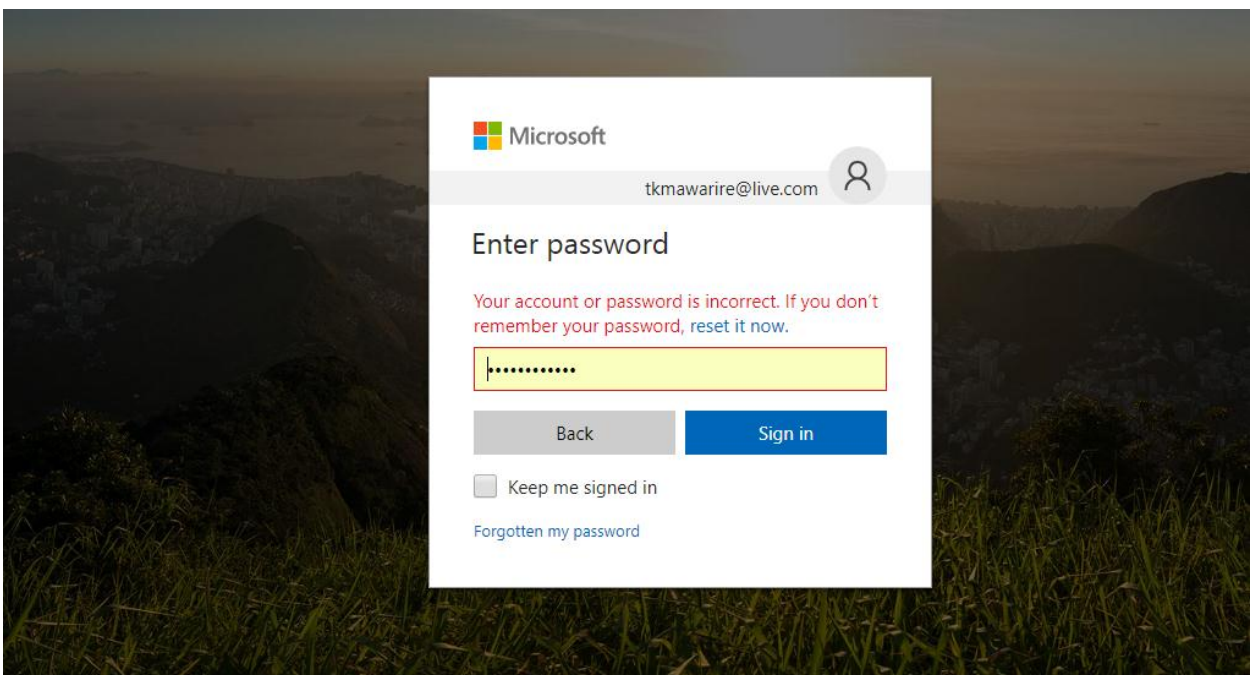

Figure 5.15: Wrong password

5.3.6.1 Physical Security

This was pursued by adopting the following processes:

- **Physical Locks:** The server, since it contains sensitive data should be monitored every time by the organisation's security. The server room will be locked and every access to it should be documented with a name to serve as aid when a threat occurs. Conditioners were put to maintain the cooling of the server and an additional power should be cited to power the server when there are power cuts. All these are situated in one room and the room is locked.

- **Log-in Book:** As cited before, there is a clocking strategy that documents every instantaneous access to the physical server. The clocking records and document the time of access and the departure time of the server room by any user who may access the room.

- **Fire Control:** The server has sensors and alarms that notify when a smoke or fire has been detected. The fire controls will put out fire in its early stages as well as warn stakeholders so that they will act as soon as they can. This meant the server on its own had to be in a compartment that ensures that the sprinklers will not put water on the server.

5.3.6.2 Software Security

This is the insurance of the system safety from intruders (techopedia.inc, 2017) and these include:

- **Database Authorisation**: SQL Server Management System has a username and password requiring technique. This will show each user access level relevant information to the data. The following represents the password and user credentials required by database manipulation:
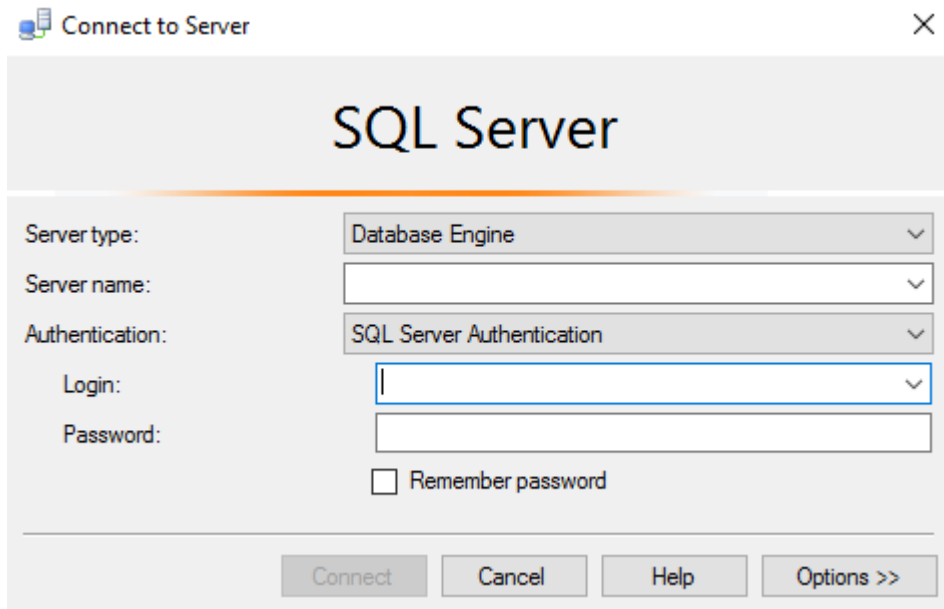
Figure 5.16 Database login

- **System User Credentials:** All users of the web based system should have user credentials that include username and password. These also include the access levels to the system information. The following depicts the user password and requirements upon entering the system that if a user does not have these cannot access the system:

Figure 5.17 Login platform

5.3.6.3 Backup

This system has an independent back up strategy that occur when there is a reinstallation of the system at any interval. The following are the types of backups the system will have

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- **Print Outs:** The system has reports that are used for audit tasks for future use. It contains queries by the users and help in planning and control of the user requirements

- **Backup Tapes**: Every weekend, the system information is downloaded on an external file and is stored offline to mitigate data loss. Some of the information is loaded on the cloud which will be accessed by the managing team.

- **Standby Server**: The system backs up itself every day after working ours when the server will be on standby. The server itself has a mirroring technique that copies information to different sleeves of the multiple drives that information will not be lost easily.

5.3.4 Acceptance Testing

After all the system functionalities have been verified as working perfectly, there came the last type of testing. Acceptance testing is referred to as the testing of the software system's acceptance to its users (softwaretestingfundamentals.inc, 2017). This was done using already supplied data by the users and have an actual feel on the information entered into the system:
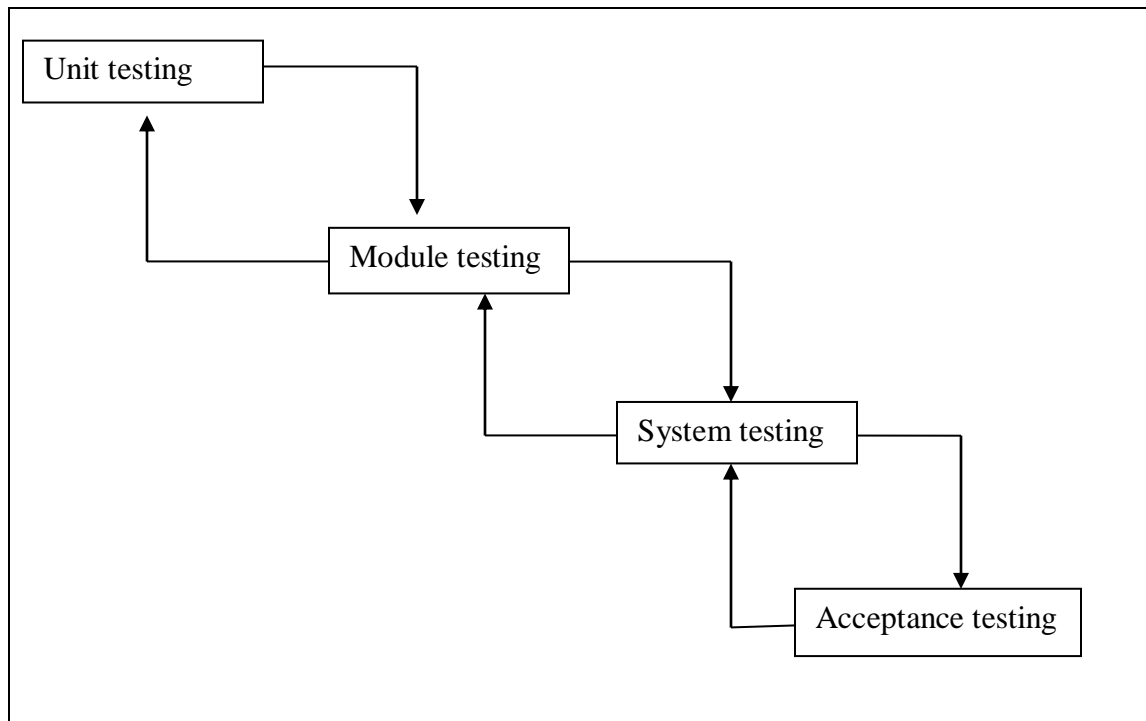

Figure 5.18: Testing

5.4 Installation

The system was deployed within the organisation as put in the design phase. The installation will include the following:

- Install SQL Server on the server
- Insert the system executable in htdocs ready for deployment in http://localhost:56194
- Run the setup script which include the database details thus creating them on the server and first time login is required

5.4.1. Training

The users should be taught on how to operate the system. Since a few people would have been acquainted during system testing, now everyone should also be educated on how the system works. Training is done at:

- **Module Level**: This is training on the users on specific modules of the system. Some users will not need to use the whole system but just a part of the system hence there is education at module level.
- **System Level**: This is education of the whole system as a whole and is normally done to management thus they have a full feel of the whole system hence making it better for them even to help their subordinates if a query of how the system works is raised.

5.4.2 Changeover

This is now the process of replacing the old system with the new system after the certified establishment of the environment and training has completed (smallbusiness.chron.com, 2017). This aimed on the full exploitation of the system and maximum user acceptance. There was an imperative focus on caution, attention and anticipation of probable faults. This implied that the system will replace and is reformatted and probable faults mitigated. The following are the changeover strategies that were available:

I.   **Pilot Conversion**

In this type of conversion the system was going to be deployed on a small department of the organisation mainly for testing. This department verifies the system functionalities. Once the department have considered it a go, the system was deployed to the whole organisation. With this technique, the risk is relatively small as it was only going to affect one department and also the department will be running both the old and new system (smallbusiness.chron.com, 2017).

II. **Direct Conversion**

Here the system directly replaces the old system at once. The old system is then considered obsolete and users start using the new system. This conversion is low in cost as only one system is in operation but there is more risk in data loss if the system is not functional or crashes (smallbusiness.chron.com, 2017).

III. **Phased Conversion**

This technique is whereby the system is installed in parts thus giving users a feel of familiarizing with the system until they are proficient in using it and slowly removing the old system. There is moderate risk since there is thorough insurance of user exploitation on the system (smallbusiness.chron.com, 2017).

IV. **Parallel Conversion (Recommended Strategy)**

This strategy now involved the old and new system working concurrently hence giving the user a fall back plan when the new system stops working. There was much labour associated with this conversion since there will be two system that will need data input. However, there was less risk since there was and still is an abundance of back up options. This strategy gave the user room to learn the system and migrate to the new system at the user's own pace (Chen, 2004). The steps in this conversion strategy included:

1. Installation of the system on the cloud
2. Train the users on how to use the system
3. Capturing of data
4. Do the same processes with the new as with the old system.

Rationale for Parallel Conversion

1. There was ample time to learn the system hence giving high productivity and maximum exploitation
2. It reduced the failure to accept the new system
3. Risk were low since there is backup

5.5 Maintenance

Maintenance, the modification of software components and hardware components to improve on performance and efficiency. This called to deliver aid when faults occur. The purpose was to have full exploitation of the system software and a greater life usage as well as good acceptance to the users (April & Abran, 2012). There are types of maintenance which include:

5.5.1 Corrective maintenance

In this type of maintenance there is a number of actions in an ongoing process. It is a continual strategy that refute error when they occur. When an error occurs, investigation is carried out and error handling activities are done. When the error has been solved, a documentation is done to book when the error occur thus helping in future cases and add as historical data for future analysis for augmentation. It focused on error handling without adding on new facets on the system.

5.5.2. Perfective maintenance

This is direct improvement of the functions at an optimum thus making it possible to confirm if upgrades are required. As system requirements changes over time, this type of maintenance was going to help in the upgrades required.

5.5.3 Adaptive Maintenance

This dealt with the changes within the system's operating sphere. It occurs when a certain area of the system environment requires changing. For instance if a computer hardware is not working, the change of the component is adaptive maintenances. This was also exercised on software components as well. If the system environment is creating a limit in the exploitation of the system functionality and when there are erratic changes in the system environment.

5.6 Recommendations

After the system had gone through the testing, testing and training, there was supposed to have recommendations to exercise the maximum exploitation of the system.

5.6.1 To the Farmers

The farmers were recommended to be updating their database since it will be constantly updated with the vast diseases that will be fed into the system database.

They needed to be savvy to send in notifications whether they deem the please report new image as not important.

5.6.2 To the Researchers

The researchers had to be able to vet the type of new photos as a threat to crop disease or not.

They needed keep the database information updated that the farmers do not render the system as incompetent.

The crop disease database had to be trained to ensure a higher level of precision

A well up-to-date browsing platform since the technologies that support the system can change

. The system should be constantly monitored to delete images without relevance thus the database under untagged does not flood with images without tags.

5.6.3 To the Administrators

The administrators needed to consider the migration of the system to a flat database that handles the storage of large amounts of data.

There was a requirement to upgrade the database into a flat database since the information will be growing and may not accommodate big data.

For more security, the organisation were recommended to consider putting on a more contemporary locking system as a biometric door and IP cameras which will help remotely manipulate the server room.

They ensure that the system is consistently well maintained and convey to their subordinates that if they face difficulties they should refer to them so that the threat may be mitigated in earnest and not cause much harm to productivity

. The administrators should also not leave unauthorised personnel to do the maintenance.

A consistent touch with the developer is also required since there may be change in user requirements.

5.6.4 General Recommendations

The users were urged to read the manual before use of the system so that they will have a familiarisation of how the system works and refer to the user manual for assistance A strong recommendation was also passed on the training of the system to increase its level of accuracy.

5.7 Conclusion

In this chapter, there was focus on the implementation of the system, how it was deployed and training as well as actual use and maintenance and monitoring of the system performance. Recommendations were also done on all the logical scenarios that were likely occur when the system requires change to best suit the user requirements. As the last chapter, the documentation of the system was thoroughly done. An in-depth survey on the problem at hand and probable solution was done. Thereafter, an answer to the question; "Should we continue to pursue this" was answered. A feasibility study was done. An analysis of the system was done checking whether the system has enough resources to achieve it and the resources that are not there easy to acquire. A logical and physical design was done which led to the actual implementation of the software system.

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APPENDIX A

USER MANUAL

Introduction

Any software system which will be greatly accepted and has maximum exploitation has to have a comprehensible system functions. A manual was done to help users when they face an error or if they want to know how the system works.

WEB USER

   a) **To login into the system**

The web user has to have a username and a password and there are two buttons, the user will have to click the sign in button. If it a first time user there will be a folder that adds a new user into the system. This is done as follows:

   b) **Login**

To enter into the system the user should provide a valid username and password. The system will use Microsoft login which will need a Microsoft account of an account linked to Microsoft account.
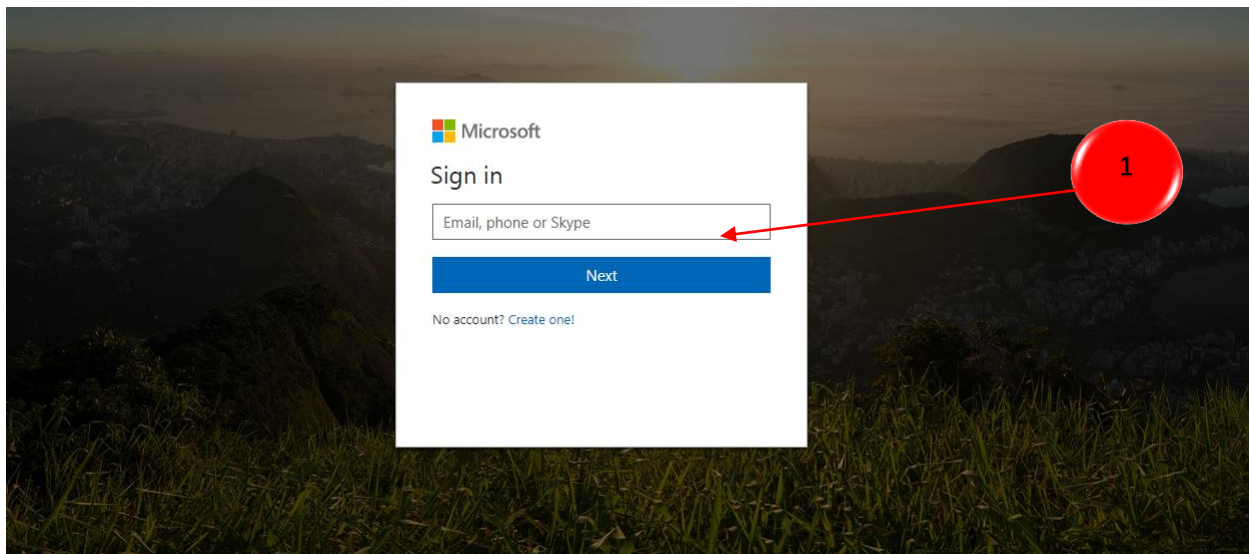
Figure A1: Login page

1-As shown in figure A1, it represents the exact place to enter their username

After inputting a username it will load and request for a password. The user will have to enter their password credentials.
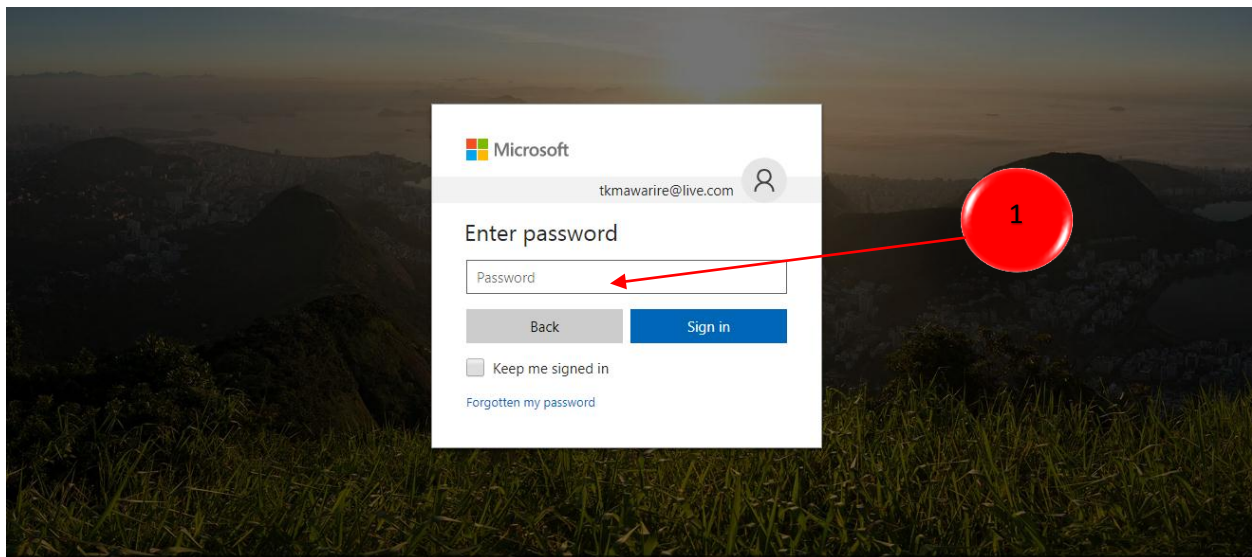

Figure A2: Password Requirement page

1: Represented in figure A2 is where you type in your password to get in the system. After you type in press the sign in button as shown in figure A2.

   c) **Forgot Credentials**

If it so happens the user will have lost their user credentials the system will help them recover the credentials to their emails as follows:
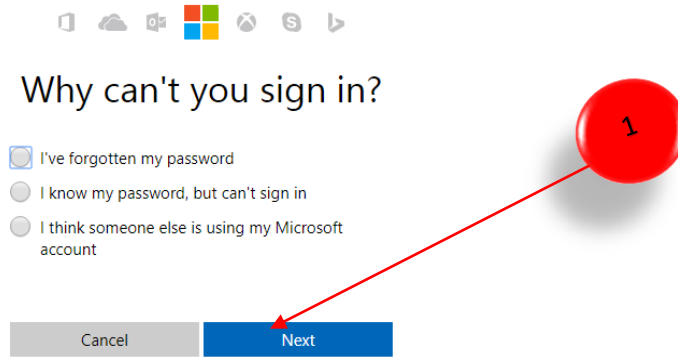
Figure A3: Forgot password

1: Press the button to start recovery process

d) To train the system to recognize the image

The system will have to learn from the test images that it will be having. So to train the system, the user will have to put in images into the system as follows:

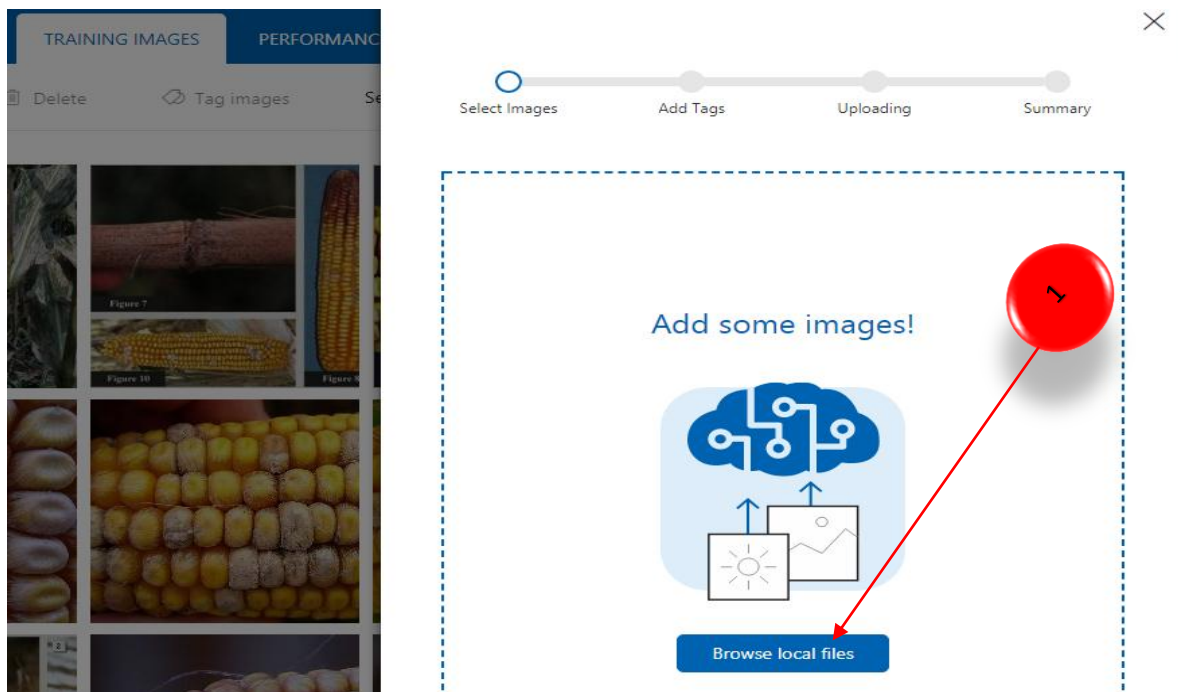#### i) Select images from your local storage are shown in figure A5

Figure A4: How to add new images for training.

ii)   **To add tags that come with the image when requested in the system**

When the user have put in the images, they will need to add tags that will populate data of the that particular type of data.
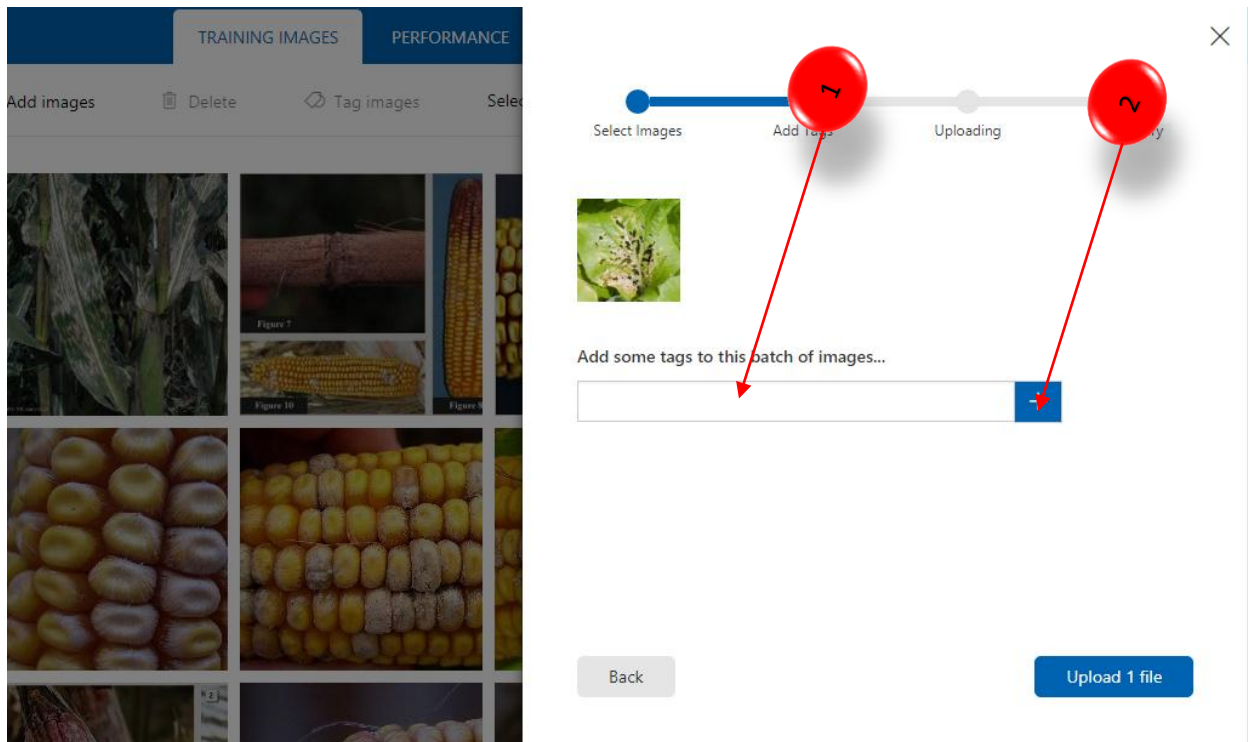

Figure A5: Addition of tags on images

To upload into the system

When an image has gotten tags it is then uploaded and it notifies when it is done uploading:

1: This is where the user inserts the tags. The user can put as many as tags as possible

2: when a tag is typed in, the user has to now press that button for the system to proceed to another step.

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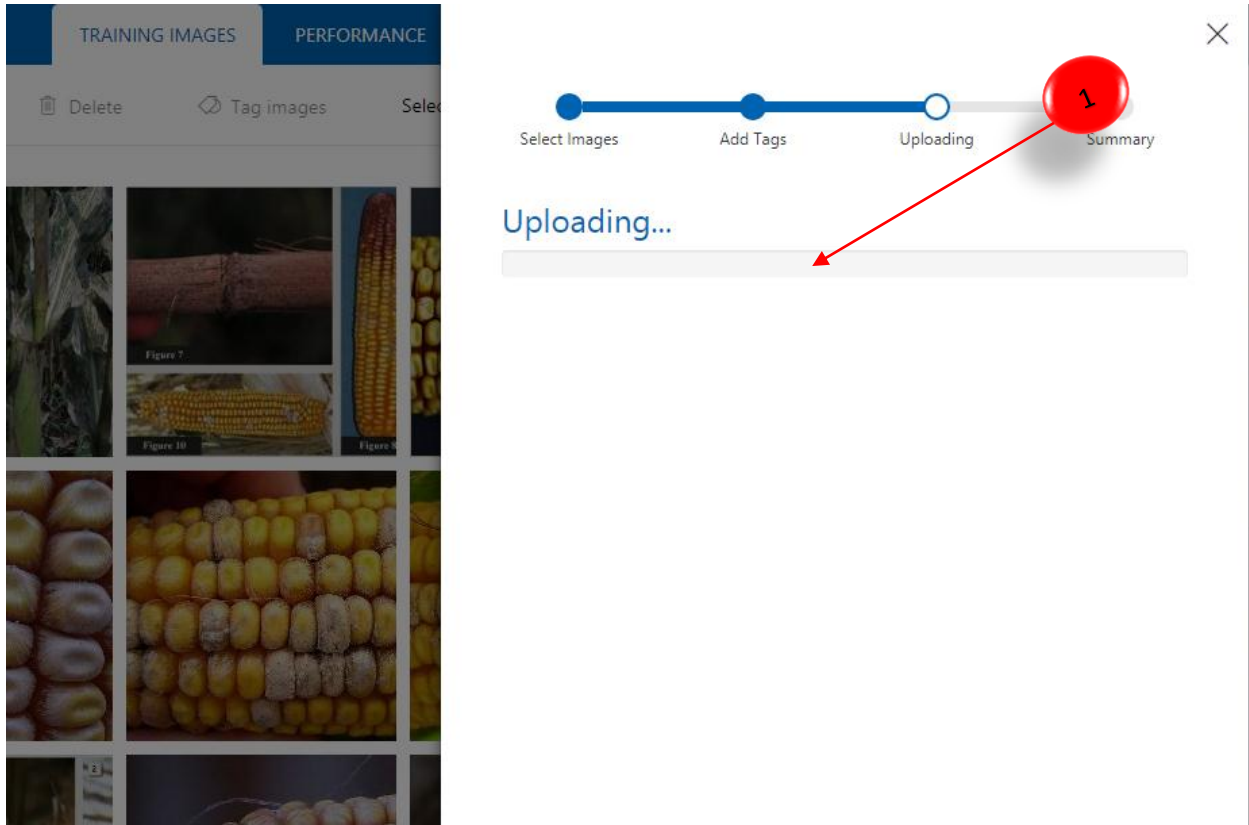### iii)   To upload the image into the system

Figure A6: Uploading the Image into the system

1: That progress bar has to complete and this may take a bit of time

When it has a notification as follows, the system will then proceed to the next step this requires Internet connection
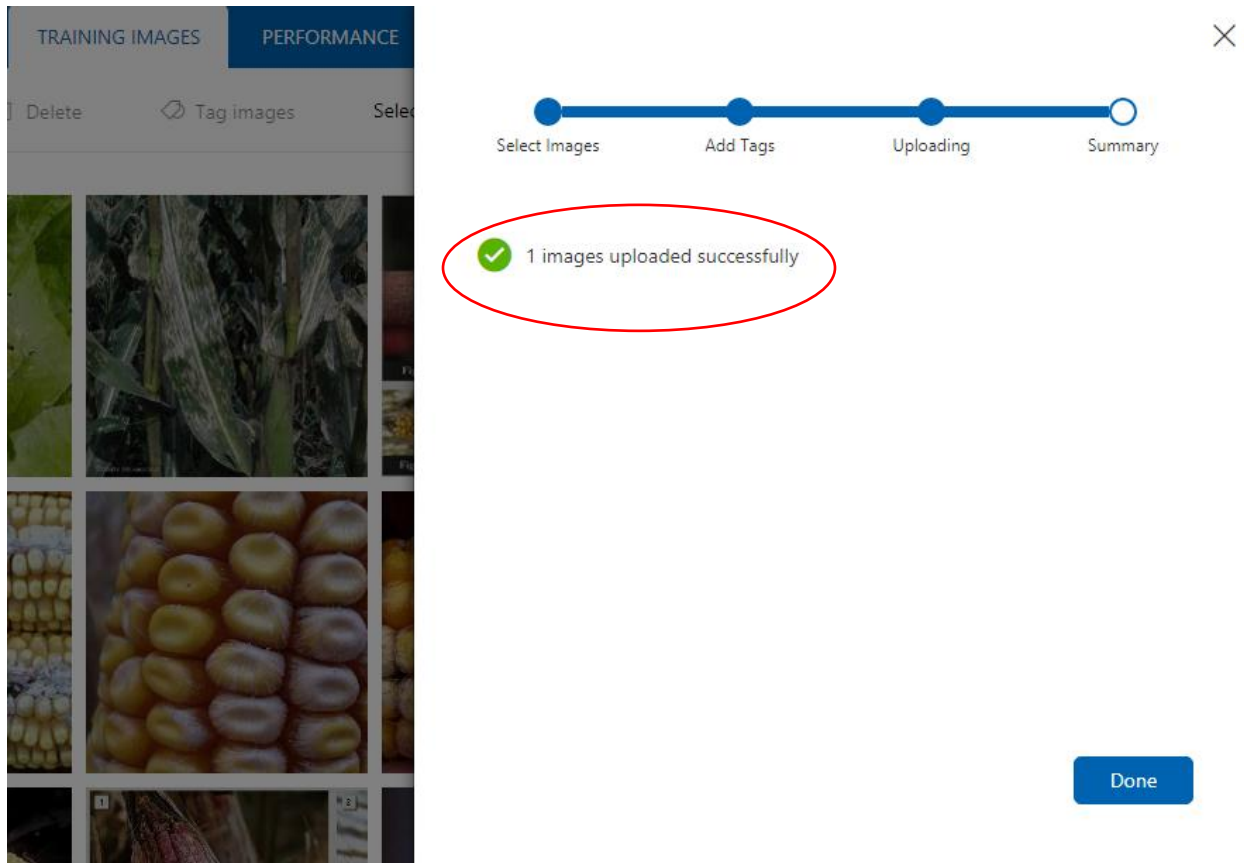
iv)   To finish up the process

Figure A9: Display of a successfully uploaded image

1: When the progress bar completes, the system flags a message. The user now can click the **Done** button

v)   To test the system

To confirm if the tests being held by the system is valid, they need to test the images to confirm its tags. For this to happen they have to do as follows. When the system has tested it will report in form of a threshold the probability of matching of the image. The optimum training percentile will be **at least 90%:**
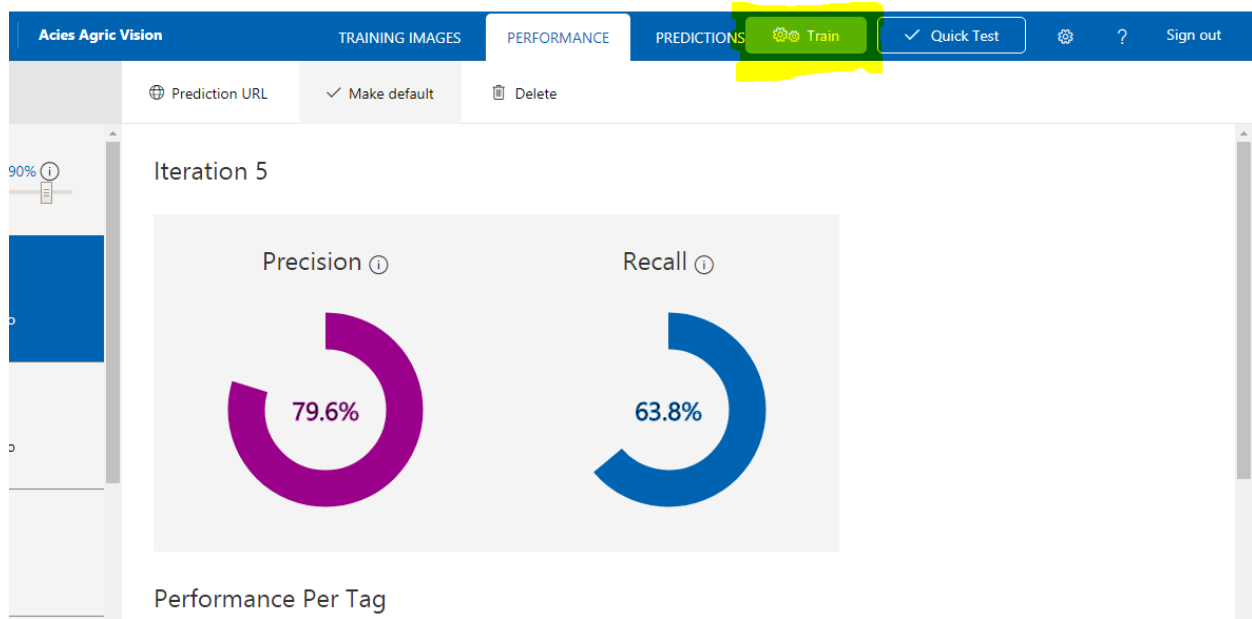

Figure A8: Image testing for precision

Click the highlighted area to train the system

vi)   **To confirm the probabilities**

When the tests are done now the user can confirm the probabilities to confirm if it valid enough to recognize any image related. This is shown if the user highlights the image. The image will show all the tags with their respective probabilities. This can be achieved as follows:
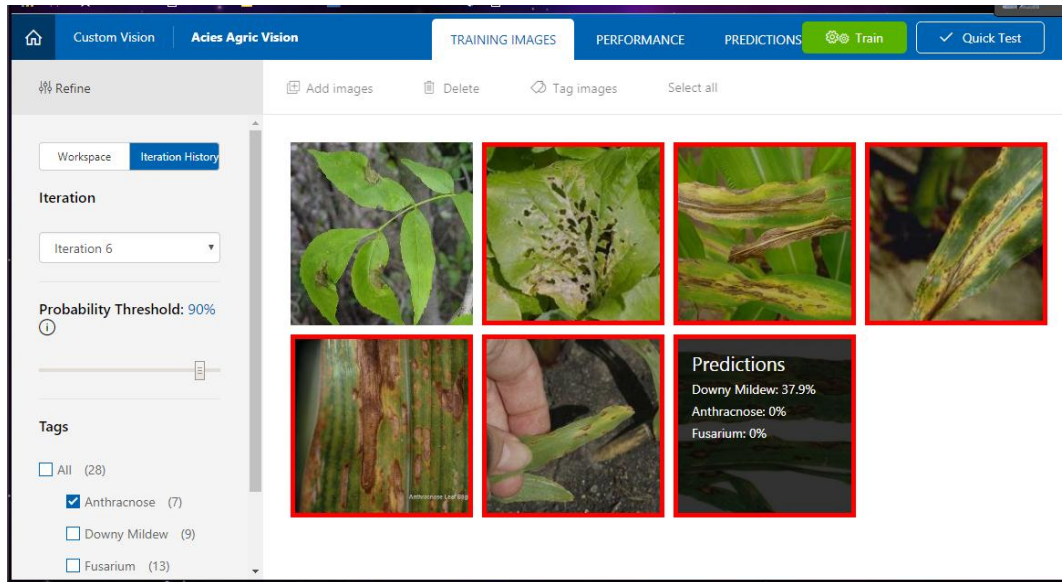

Figure A9: Tags of an image

The red boarders outlining the images depicts that the images are highlighted. When the user hover the mouse over the highlighted images, there will be the percentile of the prediction.

vii)   MOBILE USER

To capture the image

When the user open up the application it will request to capture with an okay or cancel button.

There will be two segments that will encompass the application and for the capturing they have to go the capturing platform which is represented by a button:
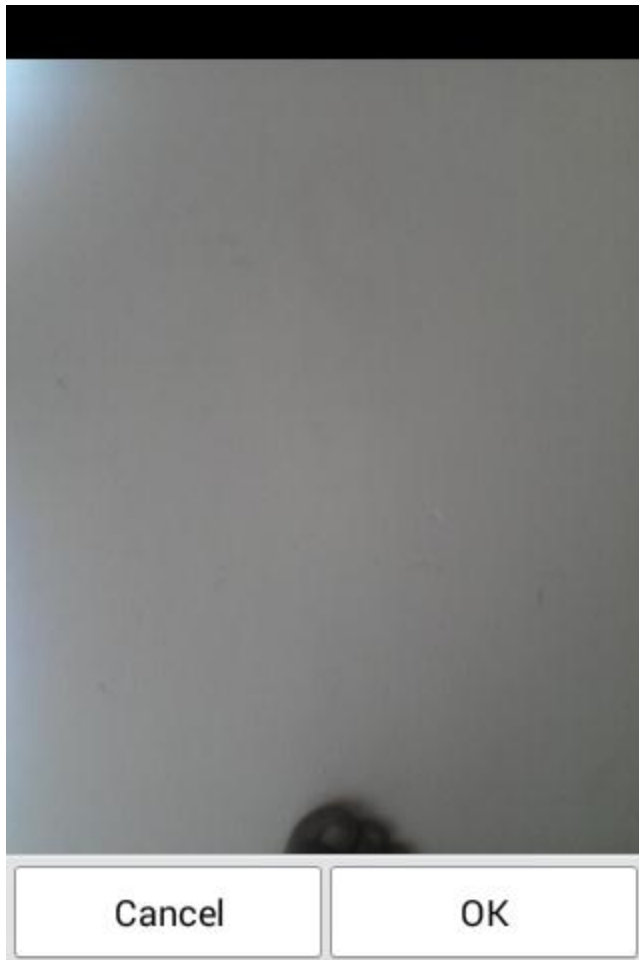

Figure A10: Taking an Image

The user has to press okay to capture the image.

viii)   To search the disease match and information

When the image has been captured, the system will search for the disease information. Whilst looking for the match, it will display a loading showing the progress of the search,
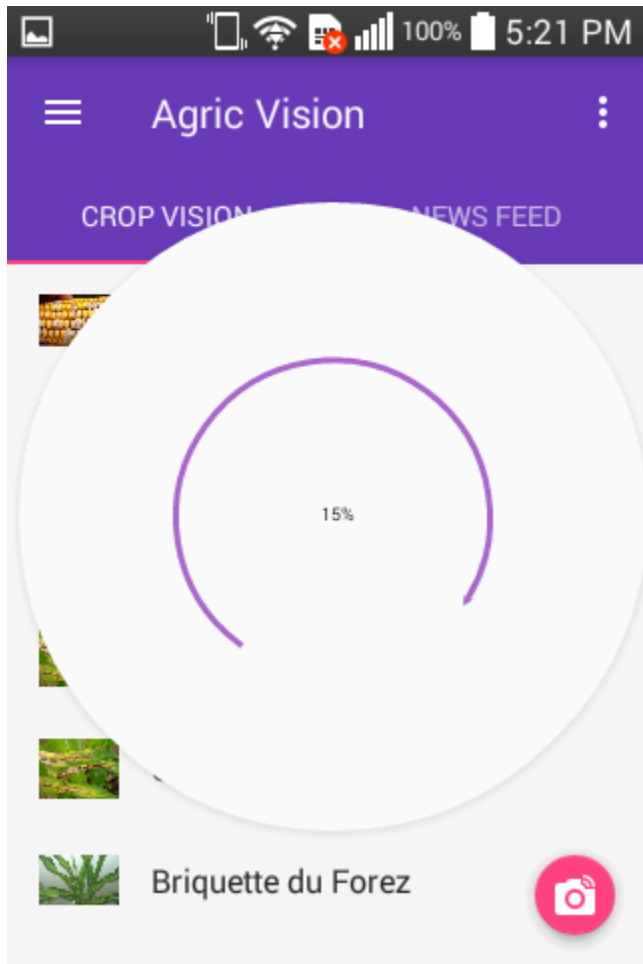
Figure A11: Retrieving disease information

ix)   To view disease information

Once the image has been captured, attached to it will be information about the crop disease as follows:
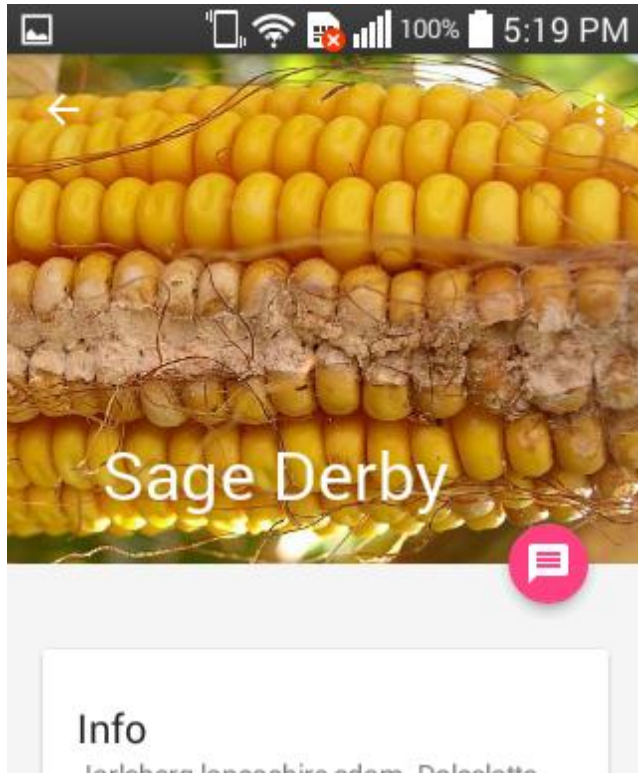
Figure A12: Information display

The system now retrieves information that is attached to matching diseases.

x)   To view the number of Testing the system has done and level of precision

In the system there will be a platform to report the number of alterations keeping track of what was done in that iteration.
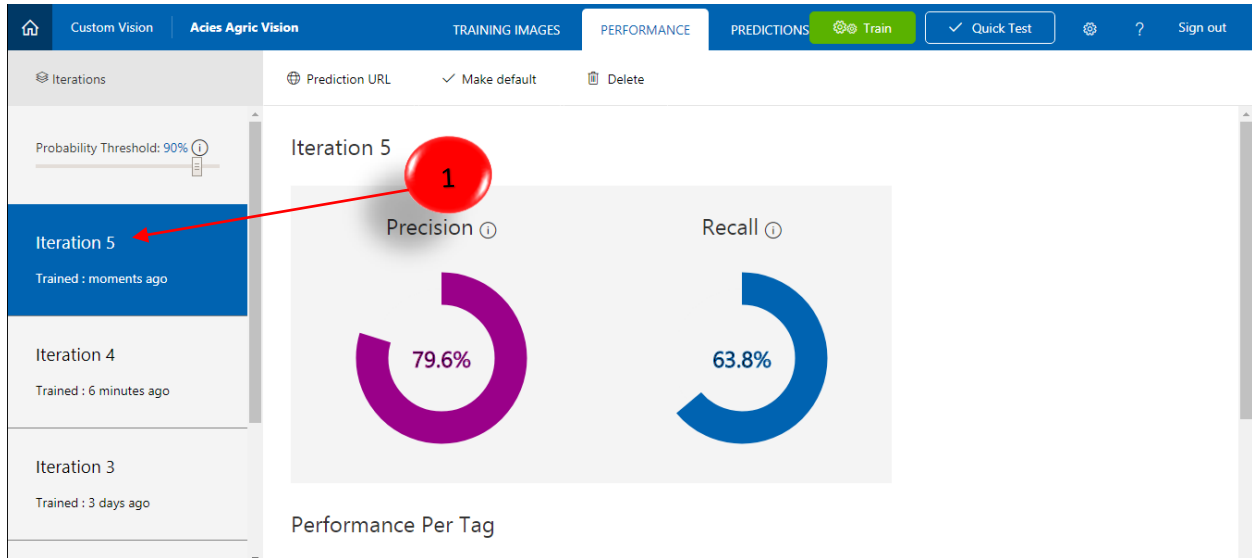
Fig A13: The number of iterations

1 -The iterations will be displayed on the left side of the system as pointed

APPENDIX B

ADMINISTRATOR QUESTIONNAIRE

INSTRUCTIONS:

Please do not write your name on this questionnaire.

Tick where appropriate and fill in where spaces are provided

---

1) Gender   **M** ☐   **F** ☐

2) Age group   **18-25** ☐   **26-30** ☐   **31-40** ☐   **41 +** ☐

3) Is there a disease research information systems here ?**YES** ☐   **NO** ☐

4) Do you document all the queries made by farmers?   **YES** ☐   **NO** ☐

5) The current system is the one you use to do all the operations of the whole organisation.

Agree ☐   Disagree ☐   Other _____

6) Your current system is able to do the following:

Database ☐   Reports ☐

Other _____

_____

7) What are the probable limitations to the use of the current system?

_____

_____

_____

8) How easy is it to perform tasks using this system?

Easy ☐   Not Easy ☐   Other _____

_____

Other Comments / Recommendations

_____

_____

_____

_____

APPENDIX C

RESEARCHER QUESTIONNAIRE

INSTRUCTIONS:

Please do not write your name on this questionnaire.

Tick where appropriate and fill in where spaces are provided

1) Gender   **Male** ☐   **Female** ☐

2) Age group   **18-25** ☐   **26-30** ☐   **31-40** ☐   **41 +** ☐

3) The current system is the system that you use to perform tasks?

Agree ☐   Disagree ☐   Other _____

4) Your current system is able to do the following:

Database ☐   Reports ☐

Other _____

_____

5) What challenges are being experienced with the current system?

_____

_____

Any Other Comments

APPENDIX D

SOURCE CODE

```
@using agricbot.Models
@model LoginViewModel
@{
    ViewBag.Title = "Log in";
}

<h2>@ViewBag.Title.</h2>
<div class="row">
    <div class="col-md-8">
        <section id="loginForm">
            @using (Html.BeginForm("Login", "Account", new { ReturnUrl =
ViewBag.ReturnUrl }, FormMethod.Post, new { @class = "form-horizontal", role = "form" }))
            {
                @Html.AntiForgeryToken()
                <h4>Use a local account to log in.</h4>
                <hr />
                @Html.ValidationSummary(true, "", new { @class = "text-danger" })
                <div class="form-group">
                    @Html.LabelFor(m => m.Email, new { @class = "col-md-2 control-label"
})
                    <div class="col-md-10">
                        @Html.TextBoxFor(m => m.Email, new { @class = "form-control" })
                        @Html.ValidationMessageFor(m => m.Email, "", new { @class =
"text-danger" })
                    </div>
                </div>
                <div class="form-group">
                    @Html.LabelFor(m => m.Password, new { @class = "col-md-2 control-
label" })
                    <div class="col-md-10">
                        @Html.PasswordFor(m => m.Password, new { @class = "form-control"
})
                        @Html.ValidationMessageFor(m => m.Password, "", new { @class =
"text-danger" })
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-md-offset-2 col-md-10">
                        <div class="checkbox">
                            @Html.CheckBoxFor(m => m.RememberMe)
                            @Html.LabelFor(m => m.RememberMe)
                        </div>
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-md-offset-2 col-md-10">
                        <input type="submit" value="Log in" class="btn btn-default" />
                    </div>
                </div>
                <p>
                    @Html.ActionLink("Register as a new user", "Register")
                </p>
```

```
                @* Enable this once you have account confirmation enabled for password
reset functionality
                    <p>
                        @Html.ActionLink("Forgot your password?", "ForgotPassword")
                    </p>*@
            }
        </section>
    </div>
    <div class="col-md-4">
        <section id="socialLoginForm">
            @Html.Partial("_ExternalLoginsListPartial", new ExternalLoginListViewModel {
ReturnUrl = ViewBag.ReturnUrl })
        </section>
    </div>
</div>

@section Scripts {
    @Scripts.Render("~/bundles/jqueryval")
using System;
using System.Collections.Generic;
using System.Linq;
using System.Net;
using System.Net.Http;
using System.Threading;
using System.Threading.Tasks;
using System.Web.Http;

namespace agricbot.Results
{
    public class ChallengeResult : IHttpActionResult
    {
        public ChallengeResult(string loginProvider, ApiController controller)
        {
            LoginProvider = loginProvider;
            Request = controller.Request;
        }

        public string LoginProvider { get; set; }
        public HttpRequestMessage Request { get; set; }

        public Task<HttpResponseMessage> ExecuteAsync(CancellationToken
cancellationToken)
        {
            Request.GetOwinContext().Authentication.Challenge(LoginProvider);

            HttpResponseMessage response = new
HttpResponseMessage(HttpStatusCode.Unauthorized);
            response.RequestMessage = Request;
            return Task.FromResult(response);
        }
    }
}
```