DESIGN AND IMPLEMENTATION OF AUTOMATED INFORMATION SYSTEM FOR AGRICULTURAL DEVELOPMENT

AGRO INFO APP

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Modernising Agriculture

BAGEYA IVAN- BU/UP/2018/3718

A report submitted in part fulfilment of the degree of

BSc in Computer Science

Supervisor: Dr. Lukyamuzi Andrew

Department of Computer Studies

Busitema University, Faculty of Science and education

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Declaration

This report has been prepared on the basis of my own work. Where other published and unpublished source materials have been used, these have been acknowledged.

Student Name: Bageya Ivan – BU/UP/2018/3718

Date of Submission: _____

Signature: _____

Approval

This is to certify that Ivan Bageya a third year student of Busitema University pursuing a Bachelor of Science in Computer Science fully did this project work for the partial fulfillment of the requirements of this degree under my supervision.

Dr. Andrew Lukyamuzi

Signature: …………………………………

Date…………………………………………...

(SUPERVISOR)

Dedication

This work is dedicated to my classmate for their love, care and sacrifices and to the memory of my late grandfather, Mulucha Wycliff. Your innocent smile, still lingers in my mind may your soul rest in peace.

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Abstract

Agriculture sector commonly utilizes broadcast media, newspapers, magazines, pamphlets, individuals, gatherings and seminars to manage information. Sometimes information is collected manually using printable forms and complaints are tabled through extension workers. This comes with challenges of delayed reporting, analysis and dissemination of information to stakeholders. The main objective of this paper is to implement an Agricultural automated information system for effective information management.

Water fall development approach was used as a development method. Tools used in this development method include; interactive Gantt charts, drag-and-drop tools for easy adjustment and adaptation to unforeseen events, HTML for structuring, PHP for a server side scripting, Java scripting (jQuery) for controls, MSQL for database development, Xampp server, bootstrap for styling and Dreamweaver code editor.

These result show that the problem of lack of appropriate and easily accessible agriculture information system can be solved using a system. After the development of the system, information about famers' profile who had registered, different pests and diseases that affect agriculture, service providers, and farm inputs as well as other information can be viewed and their locations easily identified.

The country can adopt the system so as to have a database that contains all famers' information and provide a platform that would seamless access to improved and organized agricultural information and communication dissemination system.

Chapter 1:   **Introduction**

1.1 Chapter overview

This chapter is concerned with the introduction of the research study and it presents the preliminaries, theoretical background, statement of the problem, aim and objectives of the study, significance of the study, scope of the study and organization of the research.

1.2 Introduction

According to the report by the World Bank in 2020, agriculture employees 72.44% of the whole employment population of Uganda.

Today a new paradigm of agricultural development is fast emerging: in both developing and developed countries the overall development of rural areas is expanding in new directions; old ways of delivering important services to citizens are being challenged; and traditional societies are being transformed into knowledge societies all over the world. Information and Communication Technology (ICT) is seen as an important means of achieving such a transformation. When used as a broad tool for providing local farming communities with scientific knowledge, ICT heralds the formation of knowledge societies in the rural areas of the developing world. However, this can only be realized when knowledge and information are effectively harvested for overall agricultural and rural development. The development of precision farming in countries of the North emphasizes knowledge-intensity; hence the agricultural paradigm in the developing world will have to be recast to take advantage of knowledge availability to achieve multiple goals: of income, food, jobs, etc. ICT helps the agricultural sector in re-orienting itself towards the overall agricultural development of small production systems. With the appropriate knowledge, small-scale producers can even have a competitive edge over larger operations. When knowledge is harnessed by strong organizations of small producers, strategic planning can be used to provide members with least-cost inputs, better storage facilities, improved transportation links and collective negotiations with buyers.

1.3 Theoretical Background

The technology used to implement the system is database technology. MySQL database was used as the database while Bootstrap (It contains HTML, CSS and JavaScript) was used to create an interface that will be linked to the database using PHP.

1.4 Statement of the Problem

The following problems were identified:

Many farmers lack modern knowledge of how to manage their agricultural activities to maximize yield or production.

The ignorance of the existence of information systems that can enable those in the agricultural industry to be more productive exists because only few research studies has been conducted and mainly also the limited level of sensitization about agro ICT concept.

Seminars and workshops on how ICT can contribute to agricultural development are hardly organized regularly.

Farmers do not have an information software system that can be used to gain knowledge about how to carry out their agricultural work to maximize production.

Consequently, the financial capacity of farmers is low while it has the potential to blossom. This situation necessitated this study.

1.5 Aim and Objectives of the Study

The main objective of the research work is to develop an automated information system for agricultural development.

The following are specific objectives of the study:

  i.   To determine requirements of the proposed system (needs assessment).

  ii.   To design the proposed system (Logical, Architectural and physic design).

  iii. To implement the proposed system.

  iv.   To Evaluate, Deploy and offer Tech. Support to other stakeholders

1.6 Significance of the Study

The significance of the research work are:

  o   It will provide the ministry of agriculture with a useful system that can be used to manage agricultural information.

  o   It will also aid the users to carry out their agricultural practices effectively trough the information provided by the system.

  o   The study will also serve as a useful reference material for other researchers seeking for information on the subject.

1.7 Scope of the Study

The research work covers automated information system for agricultural development using ministry of agriculture as a case study. It is limited to plants farming.

1.8 Organization of the Research

This research work is organized into five chapters. Chapter one is concerned with the introduction of the research study and it presents the preliminaries, theoretical background, statement of the problem, aim and objectives of the study, significance of the study, scope of the study, organization of the research and definition of terms.

Chapter two focuses on the literature review, the contributions of other scholars on the subject matter is discussed.

Chapter three is concerned with the system analysis and design. It presents the research methodology used in the development of the system, it analyzes the present system to identify the problems and provides information on the advantages and disadvantages of the proposed system. The system design is also presented in this chapter.

Chapter four presents the system implementation and documentation, the choice of programming language, analysis of modules, choice of programming language and system requirements for implementation.

Chapter five focuses on the summary, constraints of the study, conclusion and recommendations are provided in this chapter based on the study carried out.

Chapter 2: **Literature Review**

This chapter focuses on the literature review, the contributions of other scholars on the subject matter is discussed.

2.1 Review of Related Literature

This chapter documents the conceptualization, review of the literature, the empirical review and the summary of the research gap. Materials such as printed textbooks, journals and past copies of research work were gotten from the library and materials such as: ebooks and journals were gotten online.

Application of Information and Communication Technology (ICT) in agriculture is increasingly important (Saha, Sakib, Saquib & Hussain, 2010). Agricultural information involves the conceptualization, design, development, evaluation and application of innovative ways to use ICT in rural domain, with a primary focus on agriculture. ICT can play a significant role in maintaining properties of information as it consists of three main technologies (Mahant, Shukla, Dixit, & Patel, 2012). Adhiguru, Birthal & Kumar (2009) present an agricultural information flow which revealed that only 40 per cent farm households access information from one or the other source. The popular information sources among farmers have been reported to be fellow progressive farmers and input dealers, followed by mass media. The public extension system has been found to be accessed by only 5.7 per cent households. Only 4.8 per cent of the small farmers have access to public extension workers as compared to 12.4 per cent of large farmers. Regarding adoption of information by farmers, input dealers and other progressive farmers have depicted greater influence mainly due to easy and convenient access to these sources. The researchers suggested promotion of farmers-led extension and strengthening of public extension services to improve coverage and efficiency of agricultural information delivery systems

Tiago, Marco, Vítor, Otávio and André (2014); Kumar and Babu (2016); Weiguo, Zhengwei, Liping, Richard (2012); Zhu, Zhang and Sun (2009); Wilson (2000) have demonstrated and implemented web-GIS based information systems for agriculture using traditional GIS tools and technologies. These technologies are often insufficient to provide a complete picture of analytics in a geographic context.

Mtega & Msungu (2013) assessed how ICTs can enhance access to agricultural information needed for fostering agricultural production and agribusiness in Tanzania. Specifically, the research determined the role of specific ICTs in agricultural production and agribusiness and assessed the effectiveness of the commonly used ICTs in the creation and sharing of agricultural knowledge and information services. The researchers used a mixed approach in collecting data, relying on a structured questionnaire, interviews, content analysis and observations during the data collection. The results show that radio, mobile phones, television, computers and internet have potentials to transform the sector if they are used effectively. Mobile phones and radio were preferred as communication channel among farmers while researchers and extension staff mentioned to prefer using computers and internet. From the research findings it is recommended that internet and mobile service providers should widen their infrastructure and reduce tariffs associated with usage of their services so as to increase the number of users of their services.

The developments in ICT and the Internet in particular have revolutionized the entire agriculture field. It has generated new markets, changed the structure of the Agriculture distribution channels and re-engineered all processes. Different technology used from the perspective of agricultural research, extension, product processing and marketing. The findings reveal potential growth of the agriculture sector. The impact of information and communication technology (ICT) on access for

rural farmers on agricultural information was analyzed by (Armstrong, Gandhi, & Lanjekar, 2012) reveal that farmers were most interested in obtaining market price information without putting into consideration the need to have modern knowledge about farming and farming related activities. Examining of the relationship between use of ICT tools and co factors such as age, qualifications and income indicated that only income was a determining factor of using ICT tools. Armstrong, Diepeveen and Gandhi (2011) explain the grains value chains in agriculture, and identify the importance in developing strategies which could better secure food production. The study integrates ICTs in agricultural supply and value chains. The development of strategies to integrate these ICTs into the supply chain was proposed.

Shah, Hiremath & Chaudhary (2017) propose a spark-based information management system for agriculture and intend to reduce the technological gap between agro users and information. The work was proposed to collect, query, analyze, and visualize heterogeneous and distributed data including Geo-spatial data at scale using open source. The analytical results are explored through interactive maps and Restful adhoc Application Programming Interfaces.

Birke (2021) presented a work that aims to provide evidence on the implementation process of ICT initiatives in agriculture extension organizations and their use. The researcher provides empirical evidence on the complex interaction of social and technical actors and their assemblage to set up an ICT-based initiatives called Agricultural Knowledge Centers (AKCs); to provide empirical evidence on experts' perceptions and their use of ICTs in agriculture extension offices; and to bring insights on organizational characteristics that facilitate or hinder the learning of an organization for successfully applying ICTs in agriculture extension services. The work analyzes the innovation process of ICT-based initiatives in agriculture extension by building on the definition of innovation as an alignment of hardware (technical devices, bodily skills), software (mode of thinking, discourse, perceptions).

Chowhan & Ghosh (2020) performed a thorough review of secondary data sources; i.e. overlook of literatures from web, online published articles, reports, news etc. on some selective districts of Bangladesh to study the current features of ICT, its exercise and future prospects in the context of agriculture information and communication. The results showed that the majority of the farming group and thereby involved extension workers (SAAO) have limited access, usage, knowledge and capacity on the use of ICT tools and media. But the researchers do not consider collecting, storing, managing, and disseminating information in the Agricultural sector.

ICT in agriculture field focusing on the enhancement of agricultural and rural development involves innovative applications using ICT in the rural domain (Singhal and Shukla, 2011) the advancement of ICT can be utilized for providing accurate and timely relevant information and services to the farmers, thereby facilitating an environment for remunerative agriculture.

Chapter 3: **System Analysis and Design**

This chapter is concerned with the system analysis and design. It presents the research methodology used in the development of the system, it analyses the present system to identify the problems and provides information on the advantages and disadvantages of the proposed system. The system design is also presented in this chapter.

3.1 Area of Study

This was conducted at the ministry of agriculture, preferably in the office of commercial services Tororo local government and on the local farmers of Tororo district.

3.2 Population and Sampling

The study involved data collection from 105 respondents which include 100 famers and 4 specialist from Tororo district production department and 1 head of department in the ministry of department.

The sample was presented purposively by interview and observation methods of qualitative research.

The sampling was done purposively because my respondents are few as shown bellow

Respondent	Title	Number
Specialists	Professionals	4
Farmers	Clients	100
HOD MAAIF	Director ACDP Project	1

3.3 Data Collection and Analysis

The study considered qualitative approach to enable the researcher get deeper understanding of the problem. Therefore, the sampling considered was purposive because the number of respondents is few and the study needs direct response from the sample.

Interview was used to collect the data because it provides direct interaction between the interviewer and the interviewee.

3.3.1 Data Collection Techniques and Consideration

Below are the methods used for data collection;

- **Observation method:** The researcher observed that the method of delivering agricultural information to famers is very slow and sometimes information get to the farmers very late for them to cop up with the season beside the researcher also observed that local farmers luck information about modern methods of farming.

- **Interview method:** Tangible facts were obtained from many famers and agricultural specialist from the Tororo local district by taking the project to their awareness and it helps in getting meaningful suggestions.

- **Other Methods (Surfing the Net):** The researcher was able to gather some facts regarding the topic from different source such as magazine, newspaper, radio and internet to aid in the acquisition of knowledge's on the research.

3.4 Analysis

In this phase, there were several factors that need to be analysed such as all information or data gathered. The literature was also analysed to compare the existing system with similar systems. In addition, tools like excel were used to analyse the data collected by using graphs charts and tables.

3.4.1 Analysis of the Existing System

Currently, the system of how agriculture information reaches the farmers is not well defined and therefore communication between the farmers and the extension works is also not well defined. Most information about modern methods of farming are organized once in a while on radio stations and televisions. This leaves farmers with less or no information about climate change, changes in season, upcoming pests and diseases and less solution about how to solve such problems.

3.4.2 Problems of the Existing System

From the analysis above, the following problems were identified;

There is not clear communication tool that brings the farmers and extension workers together which leaves many farmers with less or no knowledge of how to manage their agricultural activities to maximize yield or production.

The ignorance of the existence of information systems that can enable those in the agricultural industry to be more productive.

Seminars and workshops where famers can learn modern methods agriculture hardly organized regularly.

Most farmers are illiterate in that they cannot read or write this makes it hard for the government deliver agricultural information

3.4.3 Strength of the Current System

Based on my interaction with the extension works, I discovered that the system had only one advantage which is the government employs local extension works. This make it easy since interaction can be in local language. Among others, the rest were demerits.

3.4.4 System Requirements of the New System

The requirements of the new system were classified into two categories which were; the functional requirements which is what the system should do, in other wards the main function of the system and the Non-functional requirements which are the requirements that facilitate the system to carry out its main operations.

3.4.5 Functional Requirements

- **The knowledge base:** this contains different pests and their pesticides, weeds and measures to control them, diseases and medicine and how to apply it. Besides it also contains different farming methods and how the can be carried out.

- **Extension services:** This consist of extension services like transportation, vet services, marketing services and many others services. This are purposed to extend these services to farmers.

- **Financial info:** This list different banks in Uganda which offers agricultural loans and show the maximum and minimum amount of a loan that can be taken.

- **Weather info:** Ability to check current weather condition.

- **Add/Delete Pest:** Ability to add/delete pest into/from the system.

3.4.6 Non-Functional Requirements

o Computers and phone with internet connection preferably 2GB of RAM, 1.5 GHz of Processor

o Annual Online Domain and Linux Hosting [at least 5 GB HD space]

o Electricity, power to use by the machines

3.5 Design of the system

In the design of Agro Info Application, some of the tools used are E-draw Max Software, Microsoft office suit, UML, pen, pencil and books.

3.5.1 Architecture

The Structural Design of the proposed system was carried out using the data flow diagram and use of case diagrams.

3.5.2 Context Diagram

There are three types of entities involved in the system which are the famers, service providers and the admin (extension workers/commercial workers). An extension worker/commercial workers needs to post information or data on the platform, famers have to view the information and the service provider also announce their services on the plat form.
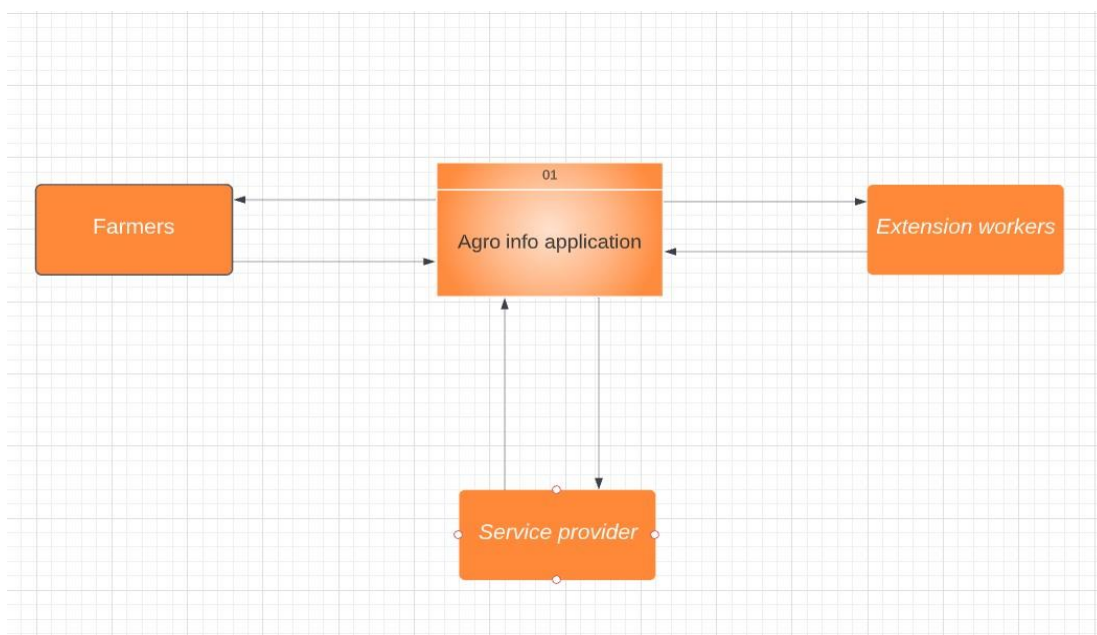
3.5.3 Flow Chart

To use this system, stakeholders need to log in first. Below is login flow chart.
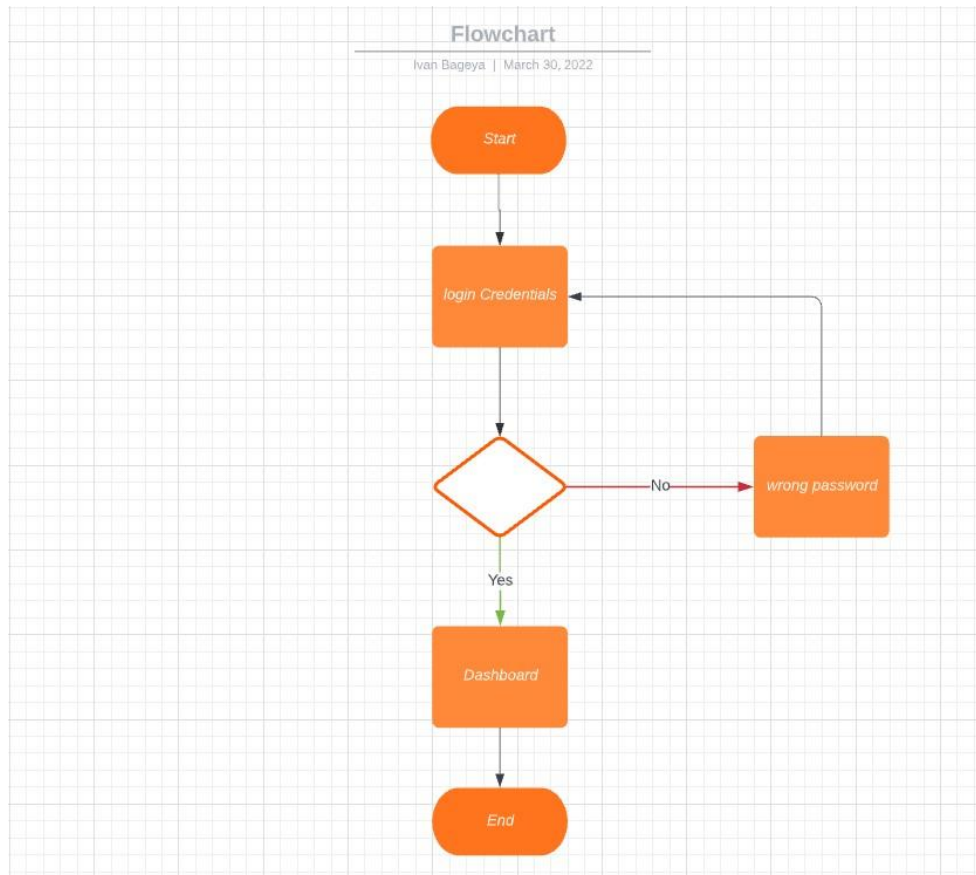

3.5.4 User case diagram

Use case diagrams for all entity present in the proposed system are shown here in details. These include the administrator who can be the extension worker and commercial worker, farmers and service providers. It shows most of the activities that are performed by the all stakeholders in the system which include login, Add/edit/delete and view pests, weeds, diseases with their controls, Add/edit/delete and view services offered by service providers and weather info.
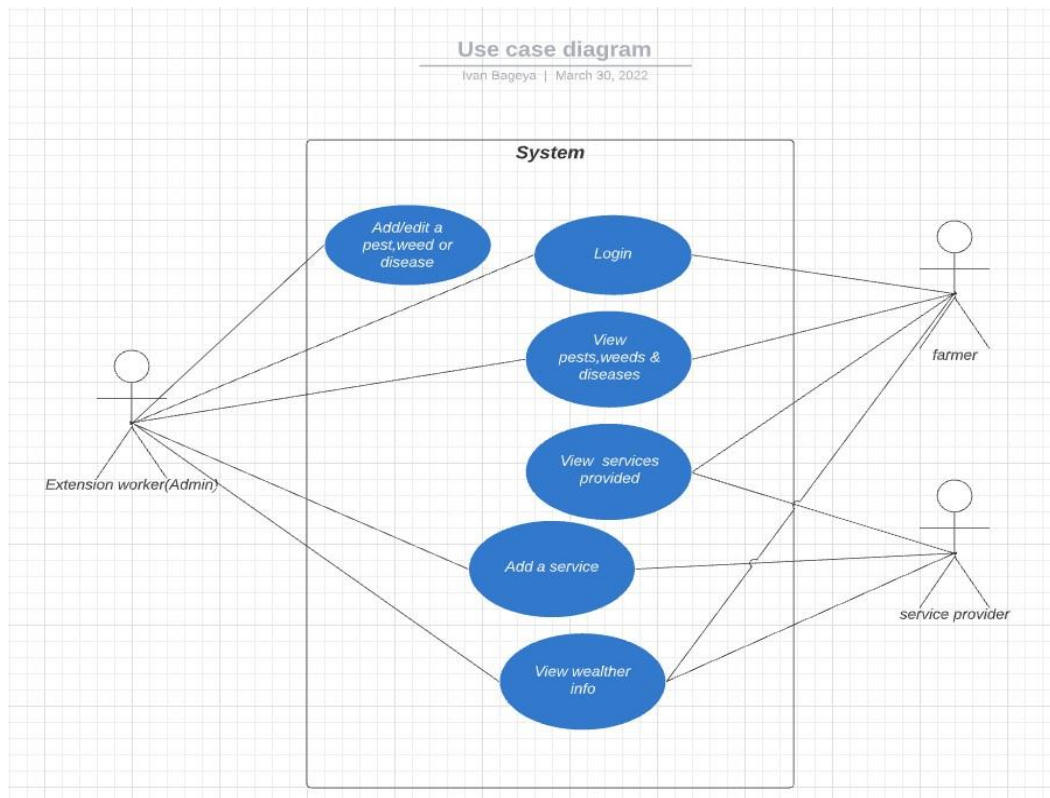
3.5.5 Database Design.

Data modelling is used for logical database design. A conceptual model of data used in an application is obtained by using an entity relationship model. The ER model defines the conceptual view of a database. It works around real-world entities and the associations among them. At view level, the ER model is considered a good option for designing databases. After designing, the database was implemented using XAMP Apache Server using MySQL database as seen below.
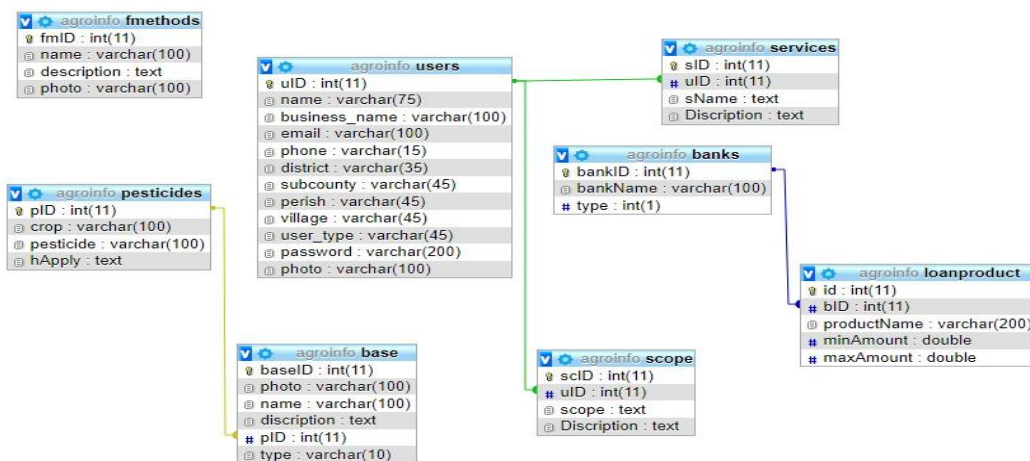
3.5.6 Interface design.

Interface design is concerned with the dialogue between a user and the computer. It is concerned with everything from starting the system or login into the system to the eventually presentation of desired inputs and outputs. The system user should always be aware of what to do next. The screen should be designed so that various types of information, instructions and messages always appear in the same general display area.

Below are some of the interfaces required for this design:

✓ Login interface.

✓ Admin Dashboard

Chapter 4: **System Implementation**

This chapter presents the system implementation and documentation, the choice of programming language, analysis of modules, choice of programming language and system requirements for implementation.

4.1 Introduction

This chapter provides detailed information about the implementation of the Agro info application. The system was designed for both web and android phone users, the programing language which was used for developing android app was java and XML while hypertext makeup language (HTML), Cascading style sheets(CSS) and hypertext processor(PHP) was used for developing a web app, my structural query language(MySQL) for database while hypertext processor was use for application development.

4.2 Input Forms

This design describes the input to the system. The first is the user interface forms. These were designed using PHP programming language with Dreamweaver as editor. Different pages/screen were developed. As shows below.
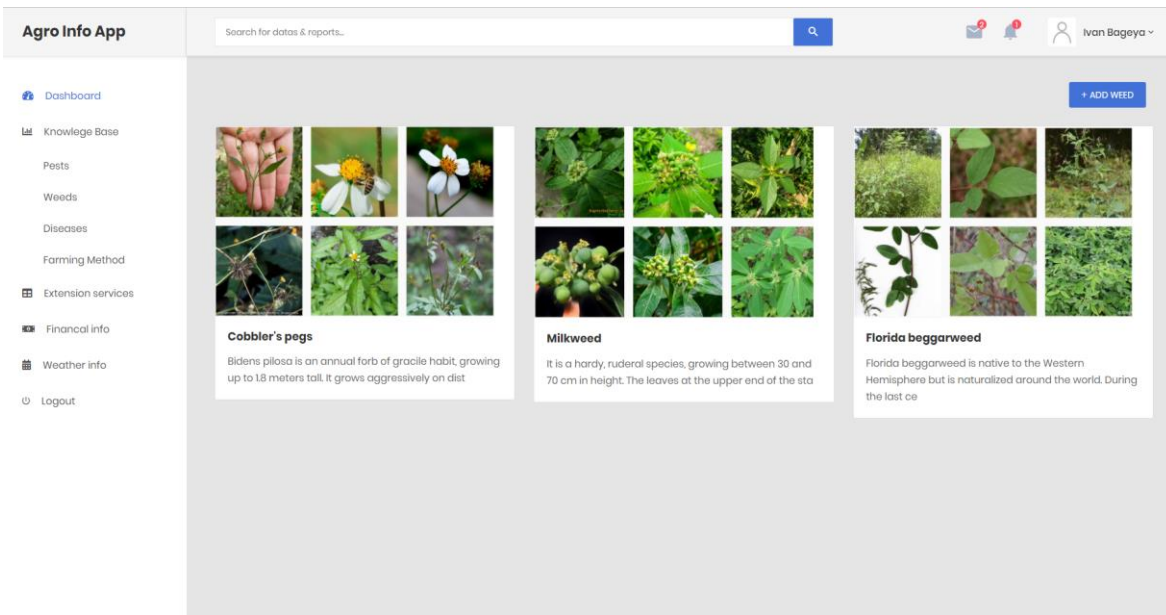
4.2.1 The login page:

This page allows farmers and research institution (Extension works) and the Admin to register, Log-In into the application. The interface form is shows below.
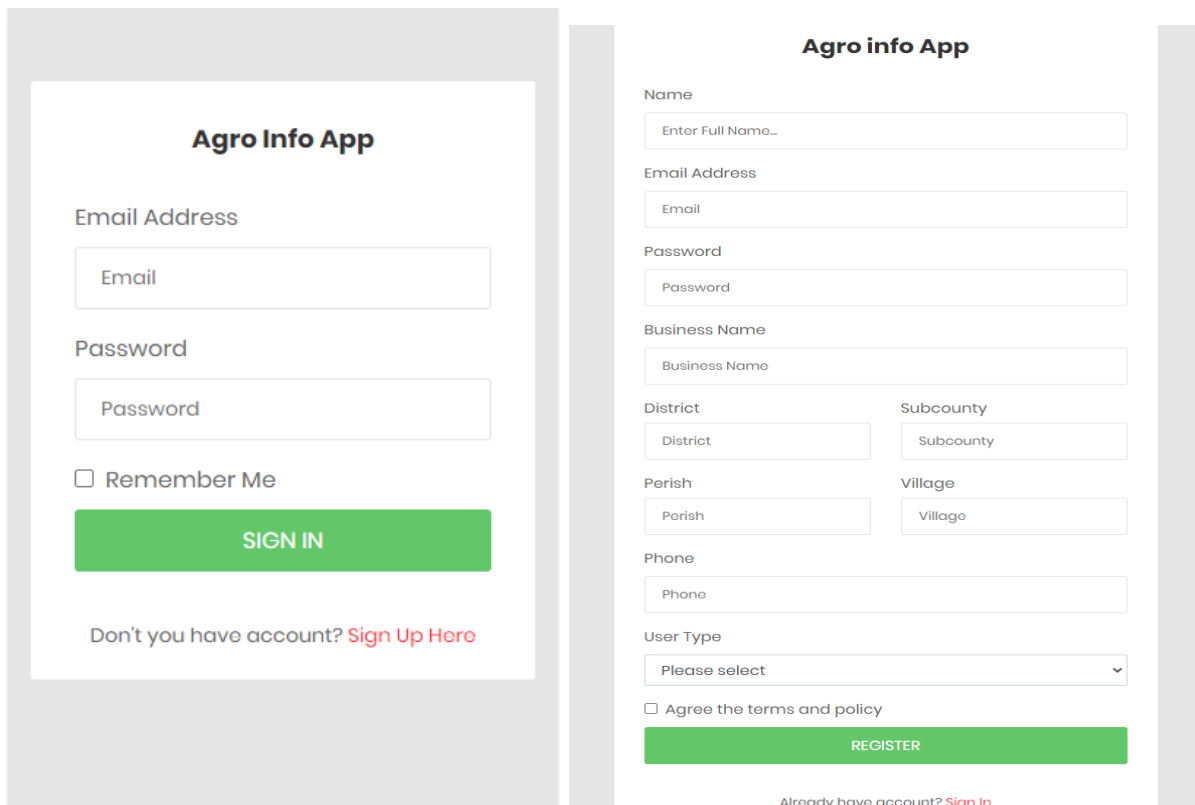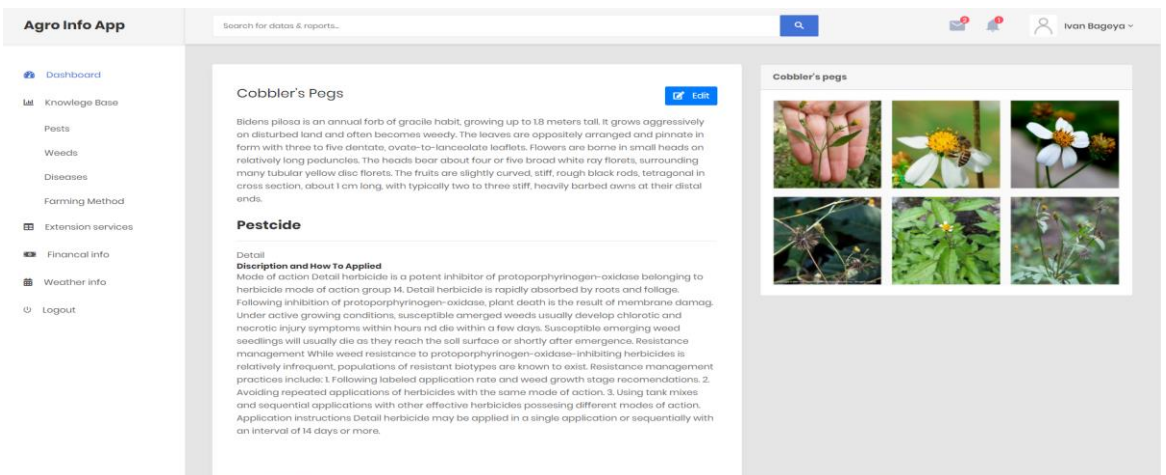
4.2.2 The Admin Dashboard
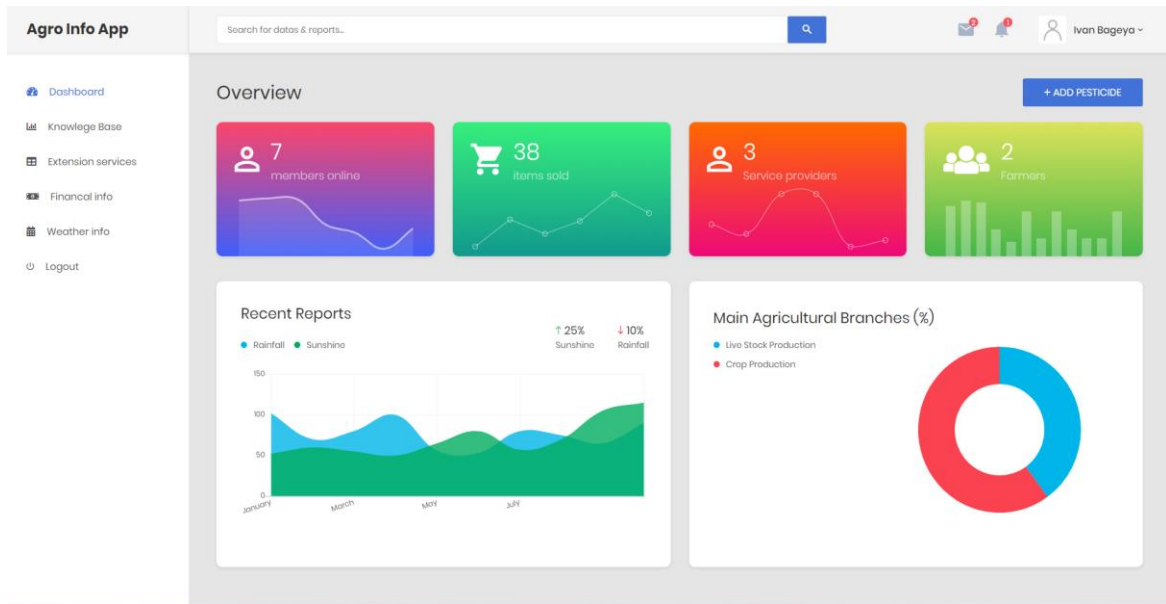
4.2.3 The Knowledge Base showing different weeds that affects plant agriculture

4.2.4 Details about a given weed

4.2.5 Extension service module

4.2.6 The weather module

4.2.7 Source Code

- The login source code

```php
<?php
require_once('../cfg/func.php');
require_once('../cfg/class.php');
require_once('../cfg/db_link.php');
$AR = new Array_Functions();

if(isset($_POST['email']) && isset($_POST['password'])){
        $u = clean($_POST['email']);
        $sp = clean2($_POST['password']);
        $p = sha1( $sp );
```

```
            $sql = "SELECT
uID,name,business_name,email,phone,district,subcounty,perish,village,phot
o,user_type,password FROM users WHERE email='$u' AND password='$p' LIMIT
1 ";
$data = $connect->query($sql) or trigger_error($connect->error,
E_USER_ERROR);
$count = $data->num_rows;
if ($count == 1 ){
$info = $data->fetch_assoc();
$id = $info['iID'];
$name = $info['name'];
$business_name = $info['business_name'];
$email = $info['email'];
$phone = $info['phone'];
$photo = $info['photo'];
$district = $info['district'];
$subcounty = $info['subcounty'];
$vilage = $info['vilage'];
$user_type = $info['user_type'];
//loading granted access sessions into memory
accessControl();
//Save login sessions
      save('l_id',$id);
save('l_uname',$name);
save('l_role',$business_name);
save('l_photo',$photo);
save('l_email',$email);
save('l_uType',$user_type);

if(isset($_POST['rememberme'])){
save("keepActive","yes");}
save("lastActive",$today);
//echo 'System Under Maintenance!!!';
$eurl = '../dash.php';
header('location:'.$eurl);
}else {                  save('msg','<span class="red"> Incorrect account
details !!!</span>');
                header('location:../index.php');
                }$connect->close();}
else {
      //echo 'You are not supposed to be here!!';
      save('msg','<span class="btn btn-danger btn-xs">Login is
required!!!</span>');
      header('location:../index.php');
}?>
```

Chapter 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

Chapter five focuses on the summary, constraints of the study, conclusion and recommendations are provided in this chapter based on the study carried out.

5.1 Summary

Based on the research work carried out at the course of the study, the work come out with system that is more usable and reliable compared to the old system of storing and disseminating information in the Agricultural sector, the system was design using PHP and MYSQL which make the system flexible and robust. However, the system is designed to minimize the problem with the old system in terms of storing and disseminating information, the new system has the ability to create, store and update information, make inquiry, and disseminating of advanced technological findings, policies and program of ministry of agricultural and rural development.

5.2 Conclusion

Automated agricultural information system if adopted will help in having a database that contains precise and accurate information concerning each and individual farmer his location, state of residence, and the type of farming he/she is into. Accurate information can be disseminated in due course reaching the targeted audience which is the farmer at the right time. Many farmers didn't have access to most of the required information to improve in their performance of crop productions. Therefore, Agricultural information system as a platform will help to address some of these issues because they now have a platform to make direct inquiring. Government interventions could be monitored and ensure that it get to the farmers, such in the area of fertilizer and seed distribution in so doing it will increase productivities and also encourage others to embrace farming as a means of livelihood which at the end will contribute to the economy at large. This study was able to come up with a framework for which farmer can interact with the research institution and extension institution that provide the farmer with the techniques for modern farming. Also, algorithm was designed in other to show the flow of information in the agricultural sector. The framework and the algorithm were developed and implemented to achieve the objectives of the research work of having a system that sored, help in retrieving and disseminating information in the agricultural sector.

5.3 Recommendations

Based on the advantages to be derived from the ICT in this modern age, this research is recommended to various Ministry of agricultural and rural development in the country, so as to have a database that contains all farmers' information and provide a platform that would provide seamless access to improved information and communication dissemination system in order to take advantage of ICT.

5.4 Limitation of the Study

The researcher faced some constraints in carrying out this research which are as follows; it is a very wide attribute that need to be clearly understood. The population size is very large as it involves almost every farmer in the country. There is issue of Internet connectivity in the local areas. Therefore, the need for government to connect every rural area with dedicated Internet for the easy access to the portal by the farmers

5.5 Future work

New agricultural information systems can be designed considering major or minor problems that might have been measured during the study. Areas such as smart agricultural video conference, between farmers, extension and research institutions can be considered. Agricultural Information System (AIS) using local languages that would also accommodate major languages in the country are hereby recommended for future work.

REFERENCES

[1] Dave Cohen and Carlos Matos. *Third Year Projects – Rules and Guidelines*. Royal Holloway, University of London, 2013.

[2] Adedokun, O. A., & Gbaje, E. S. (2016). MIS channels for effective information provision to managers of agricultural extension programmes. International Journal of Library and Information Science, 8(3), 19-26.

[3] Adeyemo, B. A. (2013). An E-farming framework for sustainable agricultural development in Nigeria, Journal of Internet and Information System.

[4] Adhiguru, P., Birthal, P. S., & Kumar, B. G. (2009). Strengthening pluralistic agricultural information delivery systems in India. Agricultural Economics Research Review, 22(1), 71-79.

[5] Armstrong, L. J., Diepeveen, D. A. and N. Gandhi, (2011). "Effective ICTs in agricultural value chains to improve food security: An international perspective. World Congress on Information and Communication Technologies, Mumbai.

[6] Armstrong, L. J., Gandhi, N., & Lanjekar, K. (2012). Use of Information and Communication Technology (ICT) Tools by Rural Farmers in Ratnagiri District of Maharastra, India. International Conference on Communication Systems and Network Technologies, Rajkot, doi: 10.1109/CSNT.2012.202.

[7] Birke, F. M. (2021). Public agriculture extension and information and communication technologies: a case study in South Wollo, Ethiopia.

[8] Chowhan, S., & Ghosh, S. R. (2020). Role of ICT on Agriculture and Its Future Scope in Bangladesh. Journal of Scientific Research and Reports, 20-35.

[9] De Araujo Zanella, A. R., Da Silva, E., & Albini, L. C. P. (2020). Security challenges to Smart Agriculture: Current State, Key Issues, and Future Directions. Array, 100048.

[10]   Demiryurek, K., Erdem, H., Ceyhan, V, Atasever, S., & Uysal, O. (2008). Agricultural information systems and application networks: the case of dairy farmers in Samsun province of Turkey.

[11]   Dave Cohen and Carlos Matos. *Third Year Projects – Rules and Guidelines*. Royal Holloway, University of London, 2013.