

Zimbabwe Electoral Commission Election Results Relaying System



Walter Ngwenya

(R125488Y)

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BY

Walter Ngwenya

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Department of Computer Science and Information Systems in the

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Supervisor: Mr T Musiwa

ABSTRACT

This researcher undertook this project with a view to help improve the relaying of results by the Zimbabwe Electoral Commission by providing an alternative route of sending results to the various command centres around the country. With this proposed system the commission will be able to swiftly collate and aggregate results much faster and precise. Also in line with the United Nations Environment Programme (UNEP) Green Economy Initiative, Zimbabwe can help reduce its carbon footprint through adopting such technologies. The aim of the research was to design an electronic results relaying system based upon the electoral process adopted in Zimbabwe by the Electoral Commission. The system is meant to complement the fax system of transmitting results and the Excel based aggregation template system used in the current setup. The main objective of system development was to facilitate the transmission of election results from the various polling stations throughout the country to the national command Centre through a network based system and also an SMS based platform. A lot of emphasis was put on ensuring the system is temper proof and very secure through the use of various security techniques like mac addressing transactions and security camera snapshots. Positive results were obtained through the feasibility study carried out which indicated a greater benefit of carrying out the research. For requirements gathering the researcher made use of focus groups and one to one interviews with some of the ZEC staff. The developed system underwent various tests to ensure that its use would not compromise results transmission during an election.

DECLARATION

I **Walter Ngwenya**, hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this to other institutions or individuals for the purpose of scholarly research.

Signature.....

Date:/...../.....

APPROVAL

This dissertation entitled **Zimbabwe Electoral Commission Election Results Relaying System** by Walter Ngwenya meets the regulations governing the award the degree of Bachelor of Information Systems Honours Degree of the Midlands State University, and is approved for its contribution to knowledge and literacy presentation.

Supervisor: Mr T. Musiwa

Signature.....

Date:/...../.....

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Although filled with great admiration and satisfaction of successfully managing to complete this project and its documentation, it would be incomplete without the mention of people whose ceaseless cooperation made it possible, whose constant guidance and encouragement crown all efforts with success.

I am very grateful to my supervisor Mr. T Musiwa and the entire staff of the Zimbabwe Electoral Commission with special mention to Mrs Mapondera ,Mr Ganyeke ,Mr Murenje and Mrs Chiswo for their guidance, inspiration and constructive suggestions that helped me in the preparation of this research.

I am also thankful to Mrs P Mahlaba and Mr B Ngwenya for their financial contributions which in turn has ensured my successful completion of this dissertation.

DEDICATION

This dissertation is dedicated to my late father and mother. May your souls forever rest in eternal peace

TABLE OF CONTENTS

ABSTRACT.....	i
DECLARATION	ii
APPROVAL	iii
ACKNOWLEDGEMENTS	iv
DEDICATION.....	v
TABLE OF CONTENTS.....	vi
LIST OF ACRONYMS	xii
LIST OF FIGURES	xiii
LIST OF TABLES	xv
LIST OF APPENDICES.....	xvi
CHAPTER 1: INTRODUCTION	1
1.1 Introduction	1
1.2 Background of the study	1
1.2.1 Background of Organization.....	1
1.2.2 Organizational structure.....	2
1.2.3 Vision.....	6
1.2.4 Mission Statement.....	7
1.3 Problem Definition.....	7
1.4 Aim.....	9
1.5 Objectives.....	9
1.6 Instruments and Methods	9
1.7 Justification and Rationale	10
1.8 Conclusion.....	10
CHAPTER 2: PLANNING PHASE	11
2.1 Introduction	11

2.2	Business value	11
2.2.1	Managerial value.....	11
2.2.2	Societal value	11
2.2.3	Employee value.....	12
2.3	Feasibility Analysis	12
2.3.1	Technical Feasibility	12
2.3.1.1	Technical expertise	13
2.3.1.2	Hardware requirements.....	13
2.3.2	Software requirements	13
2.3.2.1	Conclusion	14
2.3.3	Economic Feasibility	14
2.3.4	Tangible benefits.....	15
2.3.4.1	Intangible benefits	15
2.3.4.2	Development costs.....	16
2.3.4.3	Operational costs.	17
2.3.4.4	Cost-benefit analysis Overview	17
2.3.4.5	Return on investment (ROI)	18
2.3.4.6	Cost benefit analysis for a four year period.....	18
2.3.4.7	Net present value	19
2.3.4.8	Payback Period	20
2.3.5	Social Feasibility.....	20
2.3.6	Operational Feasibility.....	21
2.4	Risk analysis.....	22
2.4.1	Strategic Risk	22
2.4.2	Compliance Risk.....	22
2.4.3	Operational Risk	23
2.4.4	Financial Risk	24

2.4.5	Reputational Risk.....	24
2.5	Stakeholder analysis.....	24
2.5.1	Election authority.....	25
2.5.2	The contestants.....	25
2.5.3	The electorate.....	25
2.6	Work plan.....	26
2.6.1	Project Gantt chart	26
2.7	Conclusion.....	27
CHAPTER 3: ANALYSIS PHASE.....		28
3.1	Introduction	28
3.2	Information gathering methodologies	28
3.2.1	Interviews.....	28
3.2.2	Focus Groups	30
3.3	Analysis of existing system.....	31
3.3.1	Inputs.....	31
3.3.2	Processes	32
3.3.3	Outputs.....	32
3.4	Process analysis.....	32
3.4.1	Activity diagram of current system.....	32
3.5	Data Analysis	34
3.5.1	Context Diagram and DFD of the Existing System.....	34
3.6	Weaknesses of current system.....	35
3.7	Evaluation of Alternatives.....	36
3.7.1	Outsourcing.....	36
3.7.2	Improvement	37
3.7.3	In-House Development	38
3.7.4	Evaluation of Alternatives Cost Analysis	39

3.8	Requirements Analysis.....	40
3.8.1	Functional Requirements	40
3.8.1.1	Use Case diagram	41
3.8.2	Non-functional requirements (outline constraints)	42
3.8.2.1	Performance Requirements.....	42
3.8.2.2	Security Requirements.....	43
3.8.2.3	Safety Requirements.....	43
3.8.2.4	Reliability	43
3.9	Conclusion.....	43
CHAPTER 4: DESIGN PHASE.....		44
4.1	Introduction	44
4.2	System Design.....	44
4.2.1	Description of the proposed system.....	44
4.2.2	Context diagram and DFD of the proposed system.....	45
4.3	Architectural design	48
4.4	Physical design.....	48
4.5	Database design.....	51
4.5.1	Tables Structure	51
4.5.2	ER Diagram	54
4.6	Program design.....	55
4.6.1	Package Diagram	55
4.6.2	Class diagram.....	56
4.6.3	Sequence diagram	57
4.7	Interface design	59
4.7.1	Main menu	59
4.7.2	Input design (Include all input forms in the system)	60
4.7.3	Output design (Include all output forms/reports in the system)	69

4.8	Pseudo Code.....	74
4.8.1	User Authentication	74
4.8.2	Register Candidate	75
4.8.3	Results module.....	75
4.8.4	Change login credentials.....	76
4.8.5	Report generation.....	76
4.9	Security design	77
4.9.1	Physical security	77
4.9.2	Network security.....	77
4.9.3	Operational security	78
4.10	Conclusion.....	78
CHAPTER 5: IMPLEMENTATION PHASE.....		79
5.1	Introduction	79
5.2	Coding	79
5.2.1	Speech Recognition code.....	79
5.2.2	Transaction Security Camera code	80
5.3	Testing.....	80
5.3.1	Unit testing.....	80
5.3.1.1	Black box testing	81
5.3.1.2	White box testing.....	81
5.3.2	System testing	82
5.3.3	Module testing	82
5.3.4	Acceptance testing	82
5.3.5	System security testing	82
5.3.5.1	Gaining access to the database	82
5.3.5.2	Logging in to the system	83
5.3.5.3	Trying to access restricted modules.....	84

5.3.6	System Validation.....	84
5.3.6.1	System Authentication Validation.....	84
5.3.6.2	Gridview Validation	85
5.3.6.1	Textbox and Texedit Validation.....	85
5.3.6.1	Email Address Validation.....	85
5.4	Installation.....	86
5.4.1	Data migration	86
5.4.2	User training.....	88
5.4.3	System Conversion	88
5.4.3.1	Parallel Strategy.....	88
5.4.4	Direct Change-Over Strategy.....	88
5.4.4.1	Pilot Study Strategy	88
5.4.4.2	Phased Approach Strategy.....	89
5.4.4.3	Chosen Conversion Strategy	89
5.5	Maintenance (Include recommendations on maintenance strategies).....	89
5.5.1	Corrective maintenance	89
5.5.2	Adaptive maintenance.....	89
5.5.3	Perfective maintenance	89
5.5.4	Preventative maintenance	90
5.6	Recommendations for future/further development	90
5.7	Conclusion.....	91
	REFERENCE LIST.....	92
	APPENDICES	94

LIST OF ACRONYMS

AIPPA	Access to Information and Protection of Privacy Act
CEO	Chief Elections Officer
CSOs	Civil Society Organizations
NGOs	Non-Governmental Organizations
RDC	Rural District Council
RGV	Registrar General of Voters
SADC	Southern African Development Community
UNDP	United Nations Development Programme
ZBC	Zimbabwe Broadcasting Cooperation
ZEC	Zimbabwe Electoral Commission
ZESN	Zimbabwe Election Support Network
ZTV	Zimbabwe Television
DFD	Data Flow Diagram
SQL	Structured Query Language
ER	Entity Relationship diagram
EER	Enhanced Entity Relationship diagram
UML	Unified Modelling Language
SMS	Short Message Service
ROI	Return on investment.
MySQL	My Structured Query Language
ODBC	Open Data Base Connectivity

LIST OF FIGURES

Fig 1.1 HQ Structure.....	3
Fig 1.2 Provincial Structure	4
Fig 1.3 Regional Structure	5
Fig 1.4 District Structure.....	6
Fig 1.5 Results Transmission Routes.....	8
Fig 3.4.11 Key for activity diagram of current system	32
Fig 3.42 Activity diagram for the current system	33
Fig 3.3 Key for Context Diagram of the Existing System.....	34
Fig 3.4 Context Diagram of the Existing System	34
Fig 3.5 Data Flow Diagram of the Existing System	35
Fig 3.6 Key for USE CASE Diagram	41
Fig 3.7 USE CASE Diagram	42
Fig 4.1 Key for context diagram of the proposed system	45
Fig 4.2 Context diagram of the proposed system	46
Fig 4.3 Key for data flow diagram of the proposed system.....	46
Fig 4.4 Data flow diagram of the proposed system	47
Fig 4.5 Architectural design of the proposed system.....	48
Fig 4.6 Proposed polling station network diagram	49
Fig 4.7 Proposed ward network diagram	49
Fig 4.8 Proposed constituency network diagram	50
Fig 4.9 Proposed national command network diagram	50
Fig 4.10 Key for enhanced entity diagram.....	54
Fig 4.10: EER diagram for the proposed system	55
Fig 4.12 Key for package diagram of the proposed system.....	56
Fig 4.13: Package diagram for the proposed system	56
Fig 4.14: Key for class diagram for the proposed system.....	57
Fig 4.15: class diagram for the proposed system.....	57
Fig 4.17: sequence diagram for the proposed system	58
Fig 4.18: login form for the proposed system.....	59
Fig 4.19: sequence diagram for the proposed system	60
Fig 4.20 V19 form (source statutory Instrument 21 of 2005).....	60
Fig 4.21 V8 form (source statutory Instrument 21 of 2005).....	64

Fig 4.22 V11 form (source statutory Instrument 21 of 2005).....	66
Fig 4.23 V23 form (source statutory Instrument 21 of 2005).....	67
Fig 4.24 V24 form (source statutory Instrument 21 of 2005).....	69
Fig 4.25 Output design form.....	69
Fig 4.26 V15 form (source statutory Instrument 21 of 2005).....	70
Fig 4.27 V16 form (source statutory Instrument 21 of 2005).....	71
Fig 4.28 V17 form (source statutory Instrument 21 of 2005).....	72
Fig 4.29 V18 form (source statutory Instrument 21 of 2005).....	73
Fig 4.29 Log transaction report.....	74
Fig 5.1 Illustrative representation of black box testing done at ZEC	81
Fig 5.2 Sample system test.....	81
Fig 5.3 users database with encrypted passwords.....	83
Fig 5.4 security camera audit	83
Fig 5.5 Error message for restricted access	84
Fig 5.6 Login page	84
Fig 5.7 Data grid view	85
Fig 5.8 text edit illustration.....	85
Fig 5.9 Email address error message	86
Fig 5.10 MySQL installer	87
Fig 5.11 Navicat installer and sample page	87

LIST OF TABLES

Table 2.1 - Hardware requirements	13
Table 2.2 - Software requirements	14
Table 2.3 - Tangible benefits.	15
Table 2.4 - Intangible benefits.	16
Table 2.5 - Development Costs.....	16
Table 2.6 - Operational costs.	17
Table 2.7 - Cost benefit analysis table	17
Table 2.8 - Estimated Cost benefit analysis over a 4 year period.....	19
Table 2.9 - Work plan table	26
Table 2.10 - Gantt chart	27
Table 3.1 - Findings from Interviews.	29
Table 3.2 - Findings from the Focus Groups.	30
Table 11.3 - Advantages and disadvantages of outsourcing.....	37
Table 12 - Advantages and disadvantages of improvement	38
Table 13 - Advantages and disadvantages of In-House Development	39
Table 14 - Evaluation of Alternatives Cost Analysis table.....	40
Table 4.1 User database table	51
Table 4.2 transactions database table.....	51
Table 4.3 station details database table.....	52
Table 4.4 registration details database table	52
Table 4.5 log transactions database table.....	53
Table 4.6 ballot database table.....	53
Table 4.7 results database table	53
Table 4.8 candidate's database table.....	54

LIST OF APPENDICES

APPENDIX A : USER MANUAL.....94
APPENDIX B: FOCUS GROUP 103
APPENDIX C: INTERVIEW GUIDE 106
APPENDIX D: CODE SNIPPETS107
APPENDIX E: APPROVAL LETTER 110

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter will look to give a brief introduction of the proposed system by stating the aim and objectives of the study. The chapter will also aim to introduce the organization of study by looking at its background history, organizational structure and its core values. The researcher will clearly state the problem statement that has led to the proposed system.

1.2 Background of the study

The proposed Election Results Relaying System is a set of processes, functions and information within the electoral system meant to maintain election databases; perform key election events and consolidate results as well as maintain, as much as possible, audit trails in the entire electoral process.

1.2.1 Background of Organization

In 1980 upon attaining liberation, Zimbabwe's new government brought in place a new electoral system that was meant to eradicate racism and promote democracy. The Delimitation Commission assigned with the task of delimitating electoral districts and the Electoral Supervisory Commission (ESC) assigned with the general electoral conduct were formed. During this time it was the duty of the Registrar-General (R.G) to manage elections with the ESC acting as a regulator. Most of the election duties which involved voter registration, vote counting and result announcement were all done by the R.G. logistical backing during the management of elections was done by Election Directorate.

Re-structuring of the electoral management system was done in 2004. Basis of the re-structuring was from the various stakeholders which included the ESC, various political parties and organisations representing civil societies. In 2004 various heads of state in SADC adopted ideologies and procedures that should prevail in any democratic election, this also had a bearing on the reforms adopted for restructuring the electoral system in Zimbabwe. ZEC (Zimbabwe Electoral Commission) was set up in 2004 in line with the Mauritius SADC meeting.

In the year 2005 ESC was ended via an amendment to the constitution, thereby making ZEC the sole organisation responsible for undertaking and managing Zimbabwean elections. The

amendment was such that the R.G was now only responsible for registration of voters under ZEC supervision. Another amendment was made to the constitution during the global political agreement of 2009 which resulted in the present day ZEC. Currently ZEC has 9 commissioners, 7 of whom serve six year terms in office. The other two i.e. the Chairperson and the Deputy serve on a full time basis. The president of the republic of Zimbabwe is responsible for making chairperson appointments with the aid and counsel of Parliament and the judicial service commission. ZEC currently has the following commissioners.

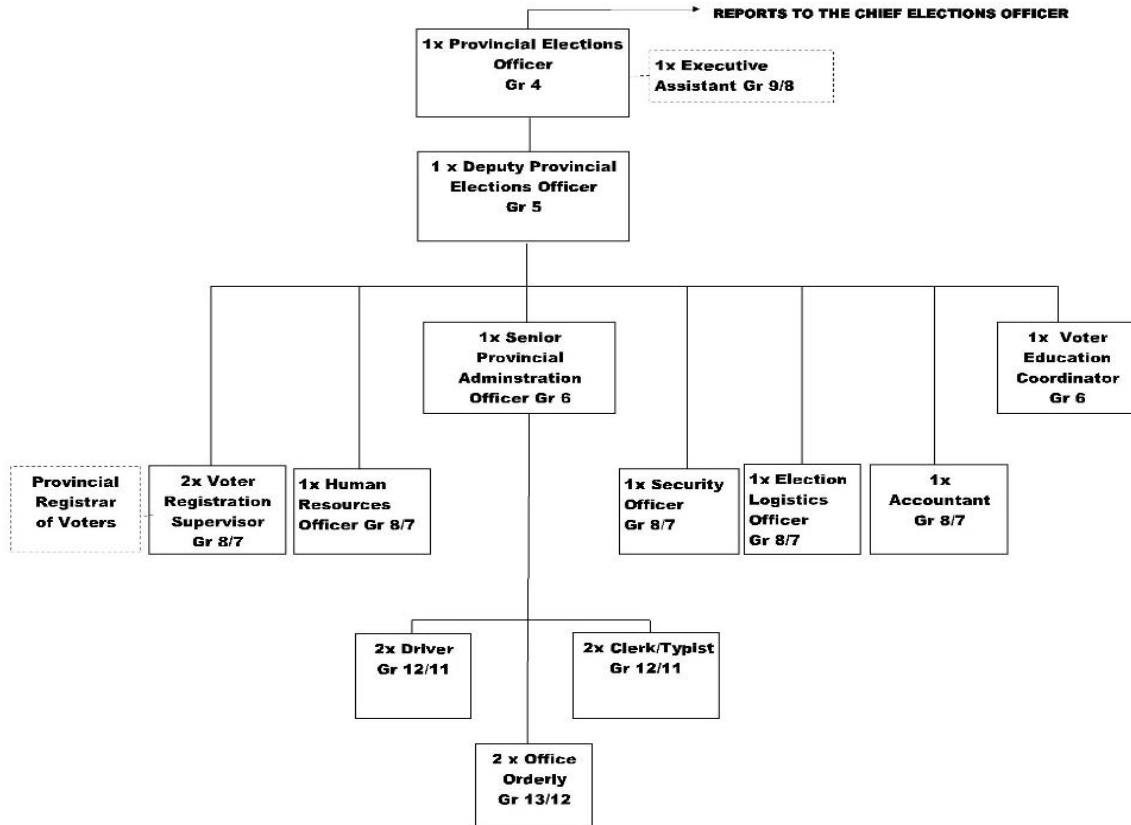
Hon Justice Rita Makarau	Chairperson
Mrs Joyce L. Kazembe	Deputy Chairperson
Mr Daniel J. Chigaru	Commissioner
Mr Theophilus T. Gambe	Commissioner
Dr Petty Makoni	Commissioner
Ms Sibongile Ndlovu	Commissioner
Mrs Bessie F. Nhandara	Commissioner
Mr Qhubani Moyo	Commissioner
Mr Emmanuel Magade	Commissioner

1.2.2 Organizational structure

According to renowned management theorist Henry Mintzberg, an organization structure defines how activities such as task allocation, coordination and supervision are directed towards the achievement of organizational aims.

The provincial structure showing the task allocation, coordination and supervision at provincial level

ZIMBABWE ELECTORAL COMMISSION: PROVINCIAL STRUCTURE

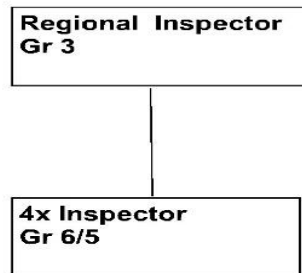


Establishment : 17x10 Provinces 170

Fig 1.2 Provincial Structure

The regional structure showing the task allocation, coordination and supervision at regional level

REGIONAL INSPECTORATE STRUCTURE



REGIONAL KEY:

NORTHERN REGION

HARARE PROVINCE
MANICALAND PROVINCE
MASHONALAND EAST
MASHONALAND WEST
MASHONALAND CENTRAL

SOUTHERN REGION

BULAWAYO PROVINCE
MIDLANDS PROVINCE
MATABELELAND SOUTH PROVINCE
MATABELELAND NORTH PROVINCE
MASVINGO PROVINCE

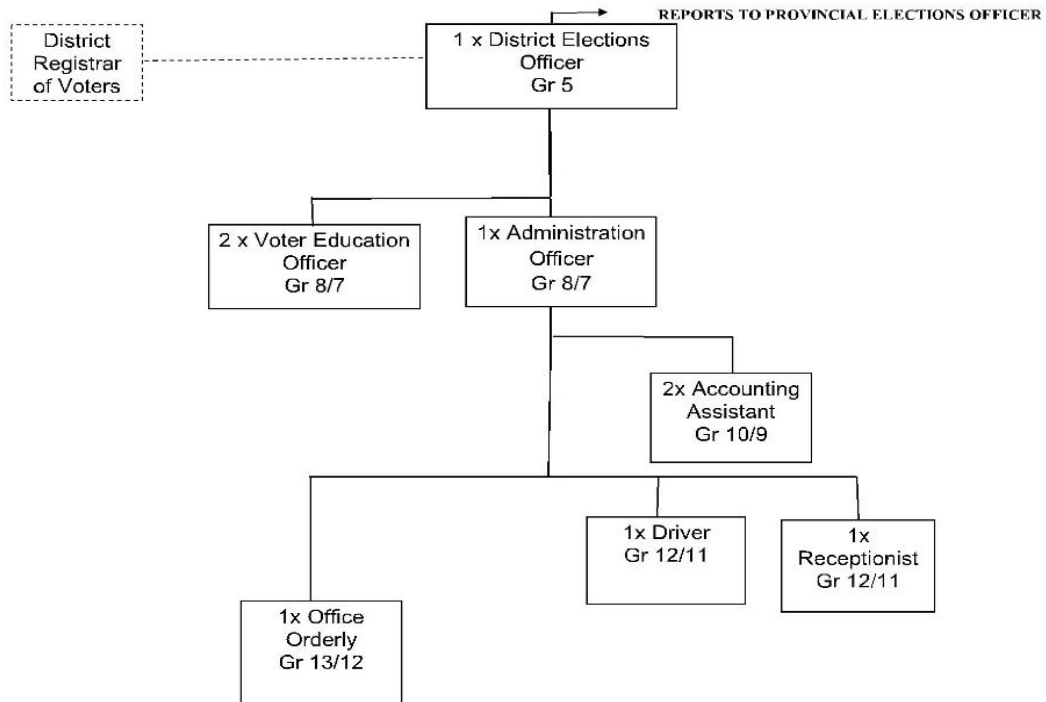
Establishment : 5 x 2 Regions

10

Fig 1.3 Regional Structure

The district structure showing the task allocation, coordination and supervision at district level

ZIMBABWE ELECTORAL COMMISSION: DISTRICT STRUCTURE



Establishment : 9x60 Districts

540

Fig 1.4 District Structure

1.2.3 Vision

According to Watson (2012) a vision shows what an organisations aims to be like in the future.

ZEC has the following vision:

To be a center of excellence in the management of elections and referendums.

1.2.4 Mission Statement

Watson goes on further to define a mission statement as the purpose of an organizations' existence which guides its actions. The mission statement for ZEC is:

To conduct elections and referendums in accordance with the laws of Zimbabwe and electoral management best practice through a well-resourced Commission and in collaboration with relevant stakeholders

1.3 Problem Definition

A description of the current system is stated below and will give a clear picture on the problems from which this researcher will look to improve on.

Local authority election results are sent to the Ward Collation Centre after the counting and verification process at various polling stations.

Presidential as well as results for the National Assembly elections are transmitted using different routes from the ward collation centre. While the destination for the National Assembly election results is the constituency centre, the Presidential results are forwarded to the district centre for onward transmission to the National Command Centre in Harare. Verification is done at each point by checking the accuracy of every collation return and whether it was properly completed. If not, corrections are to be effected by use of polling station source documents (V11)). Where facilities exist, transmission to the National Command Centre is done by telefaxing the polling station return to the Chief Elections Officer.

For validation of receipt of results, a parallel system is used to transmit and collate the presidential election results. The results are taken to the national command/collation centre physically by the District Elections Officers where they are captured and collated on a results collation template. The same results are also sent through a short messaging system (SMS) after scanning the results from the V23C form. Results are collated through these two systems and compared. Any discrepancies are corrected by going back to source documents. The two systems serve as a means of verifying the Presidential election Figs before announcement.

The Diagram in the following page illustrates the routes used in transmitting results for the 2013 Harmonised Elections.

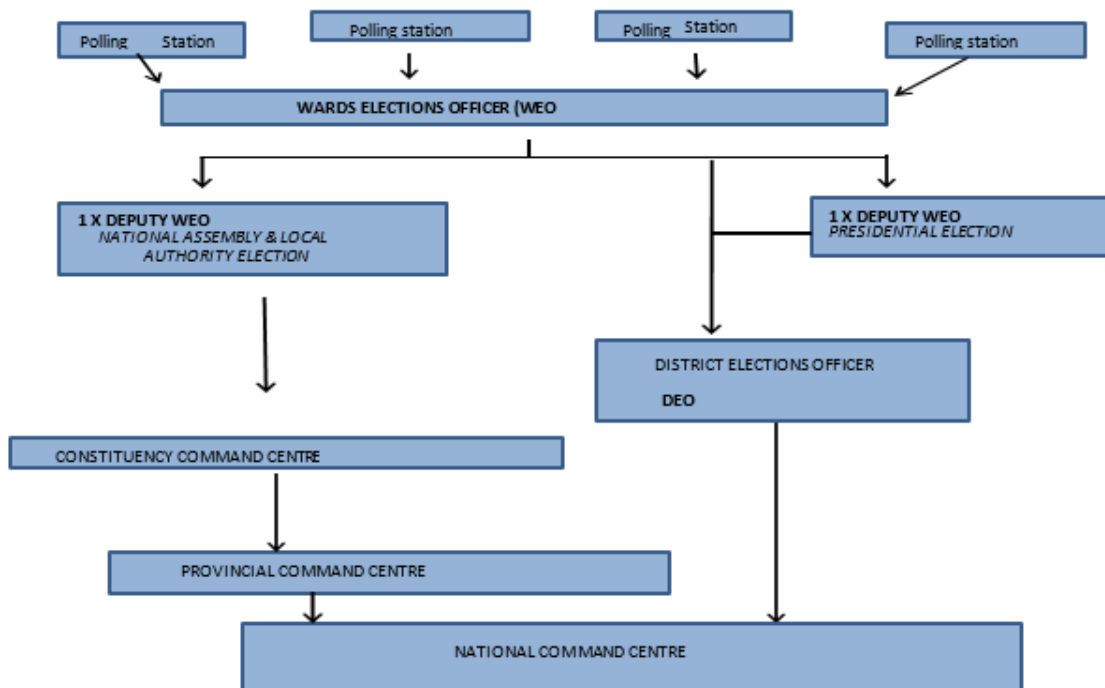


Fig 1.5 Results Transmission Routes

(Source: ZEC 2013 harmonised elections report)

A major concern to most of the public as well as some political parties is the allegedly lack of transparency in the tabulation of the results, which in this researcher’s findings, is caused by the public’s lack of proper knowledge of the electoral system rather than the system itself. The commission has made improvements to the current system, such as the counting at the polling stations and the posting of polling station results outside the station immediately after the count. However further improvements can still be made. The current system is also susceptible to a higher probability of counting and calculation errors due to fatigue or gross negligence of the election persware involved in the result aggregation process. Furthermore with the current manual system there is a considerable delay and security risk in the relaying of results to the various command centres. Another limitation with the current system is that it has a considerably high election organising cost overhead. Results transmission success hinges on the timely procurement of relevant materials which make the process very costly.

1.4 Aim

The aim of is to design an electronic results relaying system based upon the electoral process adopted in Zimbabwe by the Electoral Commission. The system is meant to complement the fax system of transmitting results and the Excel based aggregation template system used in the current setup.

1.5 Objectives

- To facilitate the transmission of election results from the various polling stations throughout the country to the national command centre
- To enable efficient and effective aggregation of election results from the ward command centres through to the national command centre.
- To provide an authentication and verification platform for the source, counting and tabulating of election ballot papers and results.
- To secure election results from hacking and manipulation as well as prevent fraud and voter privacy violation through the use of various access levels and generation of transaction history.
- To allow verifiability, i.e. the system should permit access to any accredited persons to individually verify the results tally before transmission.
- To ensure that results tally with the number of voters registered within a particular polling station, ward and constituency through queries with the voter registration database.
- To provide efficient backup of data in order to eliminate the possibility of a single server crash paralyzing the entire election results process.

1.6 Instruments and Methods

In tackling the problem at hand the system will be developed using the following tools

- Windows 7,8 or 10
- ZTE Usb modem
- Win Forms Controls DevExpress
- Visual studio .net platform
- MySQL Database Server

- MySQL ODBC Connectors

1.7 Justification and Rationale

Croll (2014 pp.32-33) states that “spreadsheets suffer from a range of problems. Several research studies have found that up to 70% of spreadsheets contain errors which would result in serious miscalculations”. Hence use of a database for these calculations will greatly improve efficiency and reduce errors for the critical job of result tallying and aggregation. Furthermore the existing setup uses faxes which generally make use of the same protocol, a fax sent from one machine can be received and printed by any other fax, regardless of whether it belongs to the intended recipient or not. As fax information is sent via the telephone network, it's theoretically possible that someone with unauthorized access to the network could intercept the information. The proposed system is meant to counter this by providing concurrent access to tabulated results as well as encryption of this data at all levels during the electoral process.

1.8 Conclusion

This chapter discussed the current weaknesses with the current relaying of results to the ZEC command centre. It also gives an evaluation of the tools and techniques that will be employed to meet the proposed system objectives. The chapter also included specific objectives that the researcher intends to meet in order to meet the aim of designing an electronic results relaying system based upon the electoral process adopted in Zimbabwe by the Electoral Commission.

CHAPTER 2: PLANNING PHASE

2.1 Introduction

In the planning phase this researcher will define the proposed solutions, what will be built, how the system will be built, who will undertake the development and the development time frame. The researcher will also prepare the relevant and most realistic work plans and cost approximations for the various system deliverables. In his book “A Systems Approach to Planning, Scheduling, and Controlling”, Harold Kerzner (2003) defines the planning phase as the part of the project where one should perform a feasibility study on the project to ascertain viability.

2.2 Business value

In its simplest form business value is the average degree for which businesses are valued. William et al (2012) identified business value as constituting intangible assets and how they add value to various stake holders of an organisation.

2.2.1 Managerial value

In order to effectively point out the managerial value of the proposed system the researcher will take a look at the impact of ICT introduction into business processes. If ZEC is to align its business strategy with its IT strategy then it will surely realize considerable value. To management the system will address the issue of facilitating transmission of election results from the various polling stations throughout the country to the national command center .This will address the logistical problems faced by the commission in trying to get all relevant source documents to the command centers. The system will also make it easy to access and generate particular reports that management may need to help in decision making.

2.2.2 Societal value

The Election Results Relaying system will add value to the society in the form of reliability. It will enable efficient and effective aggregation of election results from the ward command Centre’s through to the national command center via fail safe channels and hence giving assurance to the public of transparency.

Transparency will also be assured to the public through security provided by the proposed system. To archive this factor the system will secure election results from hacking and manipulation as well as prevent fraud and voter privacy violation through the use of various access levels and generation of transaction history. The system should also permit access to any accredited persons to individually verify the results tally before transmission.

2.2.3 Employee value

The system will have a clean look with an easy to understand interface that integrates all the various levels that election results pass through. And to prevent misinterpretation and confusion in the system the researcher will employ system form design modelled from the actual forms in the Statutory Instrument 21 of 2005 document. That way the system changeover will be flawless and easier for the personnel.

The system will be beneficial to the employees in that it will enable efficient backup of data in order to eliminate the possibility of a single server crash paralyzing the entire election results process.

2.3 Feasibility Analysis

According to Kendal, (2005) feasibility study sometimes referred to as a feasibility analysis involves a thorough examination of whether or not a particular project undertaking is viable. Upon conducting a feasibility study the judgment on proceeding or stopping a project rests the analysis results. According to a study by Standish Group, results from their study in the CHAOS report (2004) showed that a considerable percentage of ICT development projects failed before even they reach completion due to poor feasibility analysis. The study also noted that a large number of projects ended up being late and completed over budget. Consequently, this highlights the fact that before any organization undertakes a project adequate feasibility study should be done before commencement. In the following sub topics the researcher will do feasibility of the election results relaying system for ZEC.

2.3.1 Technical Feasibility

Kendal goes on to define technical feasibility as a measure of whether or not the required technology exists to implement a proposed system. The researcher will investigate and make a comparison of whether developing the new system for ZEC will be technically feasible. The

major goal will be determining the reliability and competitiveness of that system and ascertaining the limitations of any technologies to be used. Also the author will try and measure the flexibility and complexity of the proposed system.

2.3.1.1 Technical expertise

This particular researcher was fortunate enough to have worked with the IT personnel on a past project before, hence is confident on their ability to manage and troubleshoot any problems that may emanate from the system. The ZEC IT team led by their director Mrs. P Mapondera has sufficient network and programming experts that are skilled enough to undertake the project.

2.3.1.2 Hardware requirements

From the table below a list of the hardware that will be required for the system is listed.

Item	Recommended	Available
Laptops	15 000	340
ZTE Usb modem	15 000	1
HDD	At least 50 GB	250 GB+
Server	2GB Ram ,100HDD,1GHz	4GB ram,200 HDD,3GHz
System memory	At least 2GB	2GB+
Printer	Any	Hp printers
Network cards	10/100 LAN	10/100 LAN

Table 2.1 - Hardware requirements

2.3.2 Software requirements

In addition to the hardware the following software will be essential in the development of the proposed system.

Item	Recommended	Available
Operating system	Windows 8	yes
WinForms Devexpress	V15.2	yes
Visual studio	VS 2015	yes
MySQL database	Any	yes
ODBC connectors	Any	yes

Table 2.2 - Software requirements

2.3.2.1 Conclusion

ZEC is in a very good position to provide the necessary hardware and software requirements as well the necessary IT personnel to undertake the system development. The researcher can safely conclude that the system is technically feasible.

2.3.3 Economic Feasibility

Economic feasibility is evaluating the economic value of a project is an integral portion of investment review, it deals with aspects that can be enumerated, measured, and equated in financial terms (Chen 1996). ZEC can make use of results from an economic analysis along with other aspects to eventually make a well informed project investment decision. In order to undertake the project ZEC will need to use up capital funds as well as numerous other resources to produce future benefits, these can be in form of social benefits, profits, or cost saving. This researchers' job will be to convince the ZEC management if the project is worthwhile by showing how future benefits will outweigh the current proposed expenditure. For an investment to be worthwhile, the future benefit should compare favorably with the prior expenditure of resources need to achieve them.

2.3.4 Tangible benefits

Organizations can easily ascertain project worthiness through tangible benefits which are the benefits that can be valued, e.g. cost saving or revenue increase (Chen 1996). Below will be a list of the tangible benefits that will be obtained as a result of having the system in place.

NB - ZEC does not generate significant revenue hence most of its benefits are cost saving related.

Below is a breakdown of the possible tangible benefits ZEC can gain through undertaking the project.

ANNUALLY EXPECTED TANGIBLE BENEFITS	COST in USD	TOTAL
Expected cost saving	\$ 300 000.00	
Increase worker productivity (Reduction in overtime costs)	\$ 50 500.00	
Total		\$ 350 500.00

Table 2.3 - Tangible benefits.

2.3.4.1 Intangible benefits

Chen also points out that Intangible benefits are benefits are much harder to quantify unlike tangible benefits.

On the next page is a list of the intangible benefits that will likely be obtained as a result of having the system in place.

ANNUALLY EXPECTED INTANGIBLE BENEFITS	COST in USD	TOTAL
Amplified willingness	\$ 10 000.00	
Better decision making	\$ 50 000.00	
Enhanced employee determination	\$ 900.00	
Total		\$ 60 900.00

Table 2.4 - Intangible benefits.

2.3.4.2 Development costs

Wartzman *et-al*, (2010) state that development costs are the costs a business incurs from the introduction of a new product or service. ZEC will incur very little to no development cost as the entirety of the development team in part of the workforce. In-house development of the project will ensure that costs are cut and also as a security measure. The required hardware and software has already been highlighted and are mostly open source.

Below is a list of the development costs that will likely be incurred as a result of having the system in place.

ANNUALLY EXPECTED DEVELOPMENT COSTS	COST in USD	TOTAL
Stationary and consumables	\$ 800.00	
Staff training	\$ 10 600.00	
Total		\$ 11 400.00

Table 2.5 - Development Costs.

2.3.4.3 Operational costs.

Wartzman *et-al* also defined operational costs as the expenses which are related to the operation of a business, or to the operation of software. As ZEC uses the system on a day-to-day basis there are various costs that will be incurred and these have been listed in the table below.

ANNUALLY EXPECTED OPERATIONAL COSTS	COST in USD	TOTAL
Hardware Maintenance	\$ 1 500.00	
Stationary and consumables	\$ 800.00	
Backup	\$ 350.00	
Total		\$ 2 650.00

Table 2.6 - Operational costs.

2.3.4.4 Cost-benefit analysis Overview

The researcher will make an analysis of costs against benefits to help ZEC ascertain the viability of undertaking the proposed project. Expected calculations are shown below.

ANNUALLY EXPECTED COSTS AND BENEFITS	SUMMARISED TOTALS	TOTALS
Tangible Benefits	\$ 300 000.00	
Intangible Benefits	\$ 50 500.00	
Total Benefits		\$ 411 400.00
Development Costs	\$ 11 400.00	
Operational Costs	\$ 2 650.00	
Total Costs		\$ 14 050.00
Total Net Profit		\$ 397 350.00

Table 2.7 - Cost benefit analysis table

Analysis of table 2.7 in the previous page clearly shows that the benefits of adopting the system are much higher than the costs that can be incurred. This helps ZEC make a conclusion the system is economically feasible.

2.3.4.5 Return on investment (ROI)

ROI is the net cash receipts of the project divided by the cash outlays of the project. Organizations choose projects that provide the highest ROI. (Hoffer, George, Valacich)

$$\text{ROI} = \frac{(\text{Total Benefits} - \text{Total Costs})}{\text{Total Costs}} * 100 \%$$

Making use of cost benefit analysis the ROI can be calculated through substitution into the formula as follows.

$$\text{ROI} = \frac{(411\,400 - 14\,050)}{14\,050} * 100$$

$$14\,050$$

$$\text{ROI} = \underline{2828 \%}$$

The calculated figure appears very high but that is exactly the return on investment to be expected. The way the commission operates is different from a regular business where we would never expect to see such a percentage. Given the percentage it is without doubt economically feasible for ZEC to undertake the proposed project.

2.3.4.6 Cost benefit analysis for a four year period

The following table shows approximations of ZEC's cost benefit over a 4 year period

Annually expected Costs and Benefits	Year 1	Year 2	Year 3	Year 4
Tangible Benefits	\$ 350 500.00	\$ 350 500.00	\$ 350 500.00	\$ 350 500.00
Intangible Benefits	\$ 60 900.00	\$ 60 900.00	\$ 60 900.00	\$ 60 900.00
Total Benefits	\$ 411 400.00	\$ 411 400.00	\$ 411 400.00	\$ 411 400.00
Development Costs	\$ 11 400.00	0	0	0
Operational Costs	\$ 2650.00	\$ 2650.00	\$ 2650.00	\$ 2650.00
Total Cost	\$ 14 050.00	\$ 2 650.00	\$ 2 650.00	\$ 2 650.00
Total Net Profit	\$ 397 350.00	\$ 408 750.00	\$ 408 750.00	\$ 408 750.00

Table 2.8 - Estimated Cost benefit analysis over a 4 year period.

2.3.4.7 Net present value

Sehlhorst, (2006) defines Net present value, or NPV as the great equalizer of monetary study.

Net Present value = $\frac{\text{value in year } t}{(1+r)^t}$ where t is the year.

Using a discount rate of 0.08

The initial investment is 14 050

NPV for year 1 = 397 350

$$(1.08)^{-1}$$

$$= \underline{\underline{\$ 367 917}}$$

NPV for year 2 = 408 750

$$(1.08)^{-2}$$

$$= \underline{\underline{\$ 350 437}}$$

NPV for year 3 = 408 750

$$(1.08)^{-3}$$

$$= \underline{\underline{\$ 324\,479}}$$

$$\text{NPV for year 4} = \underline{408\,750}$$

$$(1.08)^4$$

$$= \underline{\underline{\$ 300\,443}}$$

To see if the project was economically feasible the calculations below shows these workings:

$$= \$ 367\,917 + \$ 350\,437 + \$ 324\,479 + \$ 300\,443 + (-\$14\,050)$$

$$= \$ 1\,343\,276 - \$ 14\,050$$

$$\text{Total Net Present Value} = \underline{\underline{\$ 1\,329\,226}}$$

According to the calculations above it can be concluded that the project is economically feasible after using the Net Present Value to make calculations which gave us a positive value.

2.3.4.8 Payback Period

Overton, (2011) defines payback period as the amount of time that the system takes to payback the initial outlay that is the amount of money used for investment. Given the nature of ZEC, unlike a business, the payback cannot be calculated as the commission does not generate income.

Given some of the accounting methods used to calculate economic feasibility it is evident that the project will enable ZEC to save considerable amounts of funds that can be then used to fund other projects.

2.3.5 Social Feasibility

Although this researcher's main aim is to raise the positive impacts of the proposed system on the society it is quite obvious that it will also to some extent have negative impacts. One of the major negative impacts is that of possible job losses and loss of possible income. Most of the ZEC employees and other government departments rely on the income they get from undertaking ZEC outreach programmes as well as election duties. That income will be reduced

in that work that was been done by a large group of people will now efficiently be automatically done by the system.

However the system will generate optimism in the community in terms of the fairness of the electoral process and encourage large numbers of new voters to register. An analysis of the eligible voter's versus the actual registered voters brings out this issue to light. A sizable chunk of the population do not actually vote although eligible due to assumption that their votes will count for nothing.

To some extent the system also promotes a pristine working environment in that whether be it the voting public, ZEC workers or contesting parties the system reduces blame between parties. The validation employed in the proposed system will make sure that all the data fed into the system is always correct and is validated thoroughly before being committed to the large pool of election data to be used in declaring election winners.

To conclude it is quite evident that the system is socially feasibly after weighing the possible advantages and disadvantages.

2.3.6 Operational Feasibility

O'Brien *et al* ,(2010) defines operational feasibility is a measure of how well a proposed system solves the problems .This researcher will undertake an operational feasibility to ascertain whether or not the proposed ZEC Election Results Relaying System will solve or enhance the organization's day to day operations. An assessment on whether the existing procedures will support the results relaying system and in what manner ZEC's employees will be affected by the system

The author will highlight the major stakeholders in the system and the impact of the proposed system.

- Voting Public- the voting public are in full support of the system as it will ensure that their individual votes will count. The system is meant to provide an element of transparency to the whole process and hence dispel assumptions made by the public that the election can be rigged.

- ZEC Employees – there is an element of resistance to the system by some employees as they deem it a threat to their jobs. Most of the extra income is gained through the manual system hence the proposed system will take away that income through automated calculations
- Contestants- the various political parties are all in support of regulations within the commission that will ensure transparent, free and fair elections and this is made possible through the proposed system.

2.4 Risk analysis

According to Kerzner (2003). Risk analysis involves the identification of the various processes that might possibly hinder the successful completion of a project and the measures that can be employed to counter such risks.

The various risks that ZEC will have to consider in relation to the system are stated below.

2.4.1 Strategic Risk

Strategic risk can be defined as the uncertainties and untapped opportunities embedded in an organization's strategic intent and how well they are executed (Waite, 2005). The strategic risk entails failure of ZEC in attaining its organizational goals and aims due adoption or rejection of the system .The mission statement of the commission is to conduct elections and referendums in accordance with the laws of Zimbabwe and electoral management best practice through resources and in collaboration with relevant stakeholders. The risk would be that if ZEC adopts the system will they still be able to remain relevant. The researchers' conclusion in this is that they will certainly remain relevant and perform their mandate effectively with the adoption of the system rather than continuing with the current system.

2.4.2 Compliance Risk

Waite goes on to define compliance risk as the risk of legal sanctions ,material ,financial loss, or loss to reputation due to failure to comply with laws ,standards and regulations. The risk in terms of compliance is a bit high in regards to the system because any changes made to the electoral act will mean the system has to be flexible enough to accommodate the changes. Most of the system form design is modelled from the actual forms in the Statutory Instrument 21 of

2005 document and hence any statutory changes made will effectively mean a change in the system design and possibly the database as well.

This risk will be addressed by the researcher by employing a programming technique known as the three tier architecture. The three-tier architecture will be employed during development of the system such that the data access layer is independent of the computer data storage and this is also independent of the interface layer. The separation of these modules allows the system to be changed and not affect the underlying platforms. The interface can change to suit the changing statutory instruments but this will not affect the overall structure of the system unlike coding on the form events.

2.4.3 Operational Risk

Operational risk is the prospect of loss resulting from inadequate or failed procedures, systems or policies (King, 2011). In as much as the researcher has noted risks emanating from external environments, there are also risks that come from within the ZEC organization that will have to be considered. These risks are known as operational risks and are the day to day operating failures that can be encountered by an organization. These operational risks can range from technical faults like server crashes or malware incompetence among other things. An example would be one of the ZEC officers using the system and entering incorrect information through the results relaying system, which will ultimately lead to a flawed election process as wrong Figs will be used to ascertain the winner of an election. As a counter measure for this particular risk the researcher has employed an authentication and verification platform for the source, counting and tabulating of election ballot papers and results which will also query the voter registration database to ensure correct Figs are recorded.

Although Zimbabwe is not known for cases of natural disaster as developers we can never rule out any possibilities. Operational risks also come in the form of outside events that are outside the control of any organization. An example would be sudden power cuts due to earthquakes or hurricanes. In such a case database servers can be corrupted and all the data lost. As such the researcher will provide efficient backup of data within the system in order to eliminate the possibility of a single server crash paralyzing the entire election results process.

2.4.4 Financial Risk

Financial risk is the probability of loss in financial methods which may impair the ability to provide adequate return (McNeil, 2005). Research has shown that the majority of risk is financial in nature meaning that there will always be a cost attached to any type of risk. In terms of ZEC there isn't much financial risk as they do not generate their own revenue for use within the organization. In relation to the system the financial risk will be in terms of wastage of resources that will be obsolete within a few years. This researcher has countered this by undertaking an in depth cost feasibility to ensure that the overall benefits outweigh any possible costs.

2.4.5 Reputational Risk

Reputational risk is a risk that an organization will lose because of poor character or quality (Kossovsky, 2014). No matter what line of business an organization is in there will always be one common risk which is reputation. To most organizations reputation means everything, such that a damaged reputation will effectively result in a business failing and also employees being demoralized.

This type of risk can be through lawsuits as an example. The system should be such that it limits the possibility of lawsuits by including documentation of all the relevant legal implications. This researcher has included a copy of the electoral act in the system to allow users to make reference as they work.

2.5 Stakeholder analysis

According to Reed, (2009) Stakeholder analysis involves the methodical collection and analysis of information to make a determination of the various groups that are involved within a particular project.

The importance of stakeholder analysis is such that it is critical to undertake it before the commencement of a project as this will result in changes to the system objectives. Step 1.4 in the WWF Standards of Conservation Project and Programme Management points out that it has to be undertaken during the problem definition stage as it is here we state the problem and who is meant to benefit.

The Zimbabwe Electoral Commission has the following stakeholders that include political parties in Zimbabwe, civil society and faith based organisations, media, Traditional Leaders and Independent Commissions among others. Below the researcher will look at three of the main stakeholders and how the results relaying system will address their expectations and interests

2.5.1 Election authority.

The Election Results relaying system is set to help ZEC which is responsible for administering elections in Zimbabwe. The system is to address the issue of facilitating transmission of election results from the various polling stations throughout the country to the national command center. This will address the logistical problems faced by the commission in trying to get all relevant source documents to the command centers. The election authority will also include observers who will benefit in that through the system it will be easy to verify results from the polling stations and also keep track of the source documents as they traverse through the various centers.

2.5.2 The contestants.

The primary contestants in an election are the candidates who are running independently or being forwarded by registered political parties, public organizations, or groups of voters. The system will also be of importance to the contestants in the following ways

- The system will secure election results from hacking and manipulation as well as prevent fraud and voter privacy violation through the use of various access levels and generation of transaction history.
- The system will also ensure that results tally with the number of voters registered within a particular polling station, ward and constituency through queries with the voter registration database.

To the contestants this is very vital as they can be sure of the outcome of elections.

2.5.3 The electorate.

The third set of stakeholders encompasses individuals who vote. The voting public can be considered at large; segmented into groups, such as women voters, young and first time voters,

or military voters; and in terms of more formal organisations and associations described in shorthand as 'civil society.' .To the electorate the system will provide the following

- It will further provide anonymity by ensuring that none of the actors involved in the voting process (organizers, administrators, voters etc.) can link any ballot (contextually) to the voter who cast it, and that no voter can prove that he or she voted in a particular way.
- The system will also provide a link to the current register voter database so that the public can verify their polling stations when misplaced.

2.6 Work plan

As stated by Kendall, (2011) a work plan is important as it will clearly outline the project stages and timeline of achieving set targets. This researcher has worked out the following work plan which will be adopted for the development of ZEC Results Relaying System. System design

On the following page is a table outlining the exact deliverable dates that will be set for the development of the Electoral Commissions’ system.

PHASES	START DATE	COMPLETION	DURATION
Proposal	20/10/2015	20/11/2015	4 weeks
Introduction	18/02/2016	25/02/2016	1 week
Planning	25/03/2016	04/03/2016	1 week
Analysis	04/03/2016	11/03/2016	1 week
Design	11/03/2016	25/03/2016	2 weeks
Implementation	25/03/2016	31/03/2016	1 week
Maintenance	31/03/2016	On Going Process	

Table 2.9 - Work plan table

2.6.1 Project Gantt chart

A Gantt chart is a project management tool for planning and scheduling projects (Lock, 2009). The following Gantt chart is derived from the work plan above and will be used by the

commission to track progress of the project. Any delays in any of the phases might ultimately result in the overall delay of the project.

Phase	Week										
	1	2	3	4	5	6	7	8	9	10	11
Project Proposal	■										
Introduction					■						
Planning						■					
Analysis							■				
Design					■			■			
Implementation								■		■	
Maintenance											■
Documentation	■										

Table 2.10 - Gantt chart

2.7 Conclusion

Given the conducted research the researcher has no doubt on the feasibility of the system in meeting the aim of the project which is to design an electronic results relaying system based upon the electoral process adopted in Zimbabwe by the Electoral Commission. The subsequent chapter will look at analyzing how the current system works.

CHAPTER 3: ANALYSIS PHASE

3.1 Introduction

According to Rossett and Sheldon, (2001) Analysis involves the study to ascertain whether to undertake a certain project or not.

In the previous phase this researcher defined the proposed solutions, what will be built, how the system will be built, who will undertake the development and the development time frame. This chapter will look to provide a clear explanation of the current problems and objectives. It will look at the information gathering methodologies that will be employed, analyse the current system so as to point out the weaknesses against the strengths. The researcher will also perform a process and data analysis in addition to the evaluation of alternatives.

3.2 Information gathering methodologies

In order for this researcher to gather adequate system requirement from ZEC various information was gathered. All this was done with a view to gather a precise understanding of how the current election results relaying system works including persware, functions and type of data involved. However not all information gathering methodologies yield true and accurate reflections on the ground hence caution had to be taken in choosing the requirements gathering technique to use.

The researcher used the following methodologies to gather system requirements.

- Focus groups
- Interviews

3.2.1 Interviews

Warren and Karner, (2005) in their highly respected publication “Discovering qualitative methods: Field research, interviews and analysis” note that Interviewing involves asking questions and getting answers from participants in a study. This researcher engaged the ZEC employees and conducted various interviews with the management responsible for the relaying of results and also the I.T management.

The following are some of the reasons why the researcher chose to use Interviews as an information gathering technique:-

- Oral communication enabled the researcher to get an intimate feel of the system through dialogue with the interviewees. This helped get a good understanding of the how the system really worked and the processes involved.
- The researcher was able to gather in-depth views and thoughts from all the group attendees

The Interview methodology however had the following disadvantages:-

- The researcher noted that interviewees sometimes rushed in answering questions and sometimes changed their positions multiple times.

Brief outcomes from conducted interviews

Question	Common response
1. Brief description of the current system?	It involves a lot of manual operations that requires time to complete
2. How long does it take to track down source of a calculation errors?	It takes long hours even a day or two to pinpoint where an error emanates from.
3. Are you satisfied with the current system?	Satisfied but improvements would be most welcome
4. What are your views on the proposed system?	Certainly a great idea that would improve efficiency and cut operational costs
5. Do you think a computerized election results relaying system will help solve problems experienced in the current system?	Most of the interviewed persons answered yes noting the precise calculations that can be attained using computers.
6. Comments or suggestions	The system should in future allow the public to see results in real-time via their mobile phones or via websites.

Table 3.1 - Findings from Interviews.

3.2.2 Focus Groups

Durance (2005) defines a focus group as a form of interviewing that involves group discussions with the motive of gathering enough information about the topic of discussion from a large pool of people at once. The discussion structure is clearly outlined beforehand so that participants can effectively prepare.

The researcher found this approach to be effective in that it was easy to gather in-depth analysis of the system from the ZEC employees. The author noted that by conducting focus groups more ideas could be generated than conducting individual interviews.

The following are some of the reasons why the researcher chose to use Focus groups as an information gathering technique:-

- The employees taking part in the focus groups did not require reading or writing skills as the technique mainly relied on oral communication.
- The researcher was able to gather in-depth views and thoughts from all the group attendees

The Focus group methodology however had the following disadvantages:-

- The researcher was not able to generate required statistical data from the discussions. Deep insight could be obtained however useful numeric information was hard to obtain as well as verify.

Summarized results from the focus groups

Question	Popular answer
1. Comment on the current system?	It is quite effective although computerizing the process would bring great efficiency.
2. Will computerizing the system be beneficial to you?	In terms of efficiency, Yes. But in terms of income generated by employees ,No
5. How best should the system be implemented once development is complete?	Most participants agreed a parallel changeover would be best although costly.

Table 3.2 - Findings from the Focus Groups.

3.3 Analysis of existing system

A description of the current system is stated below and will give a clear picture on the problems from which this researcher will look to improve on by developing a computerized election results relaying system.

Local authority election results are sent to the Ward Collation Centre after the counting and verification process at various polling stations.

Presidential as well as results for the National Assembly elections are transmitted using different routes from the ward collation centre. While the destination for the National Assembly election results is the constituency centre, the Presidential results are forwarded to the district centre for onward transmission to the National Command Centre in Harare. Verification is done at each point by checking the accuracy of every collation return and whether it was properly completed. If not, corrections are to be effected by use of polling station source documents (V11)). Where facilities exist, transmission to the National Command Centre is done by telefaxing the polling station return to the Chief Elections Officer.

For validation of receipt of results, a parallel system is used to transmit and collate the presidential election results. The results are taken to the national command/collation centre physically by the District Elections Officers where they are captured and collated on a results collation template. The same results are also sent through a short messaging system (SMS) after scanning the results from the V23C form. Results are collated through these two systems and compared. Any discrepancies are corrected by going back to source documents. The two systems serve as a means of verifying the Presidential election Figs before announcement.

3.3.1 Inputs

- Returns from the various polling stations which are known as V.11 forms and used for all election types.
- V.23 forms used to verify and collate polling station V.11 forms on receipt.
- V.24 part A form which is a verification of postal voters form
- V.19 forms to be used for all election types known as the declaration of secrecy form
- V.20 forms used for the capturing of nomination details for a presidential election.
- V.9 and V.10 forms for ballot papers of parliament members and presidential office respectively.

3.3.2 Processes

- Counting of votes.
- Aggregating results from all polling stations up to the command Centre.
- Transmitting results
- Declaring winners at various stages of the electoral process.

3.3.3 Outputs

- Declaration form of poll results
- V.15 form via email or telegram with particular polling station ,ward or constituency result
- V.16 form via email or telegram with presidential result
- Election statistics including gender and turnout among other metrics.

3.4 Process analysis

Anderson, (1999) described process analysis as relations that are coherently in series and offer the capability of changing inputs into results. Through the use of an activity diagram the researcher will seek to highlight the processes involved in the system.

3.4.1 Activity diagram of current system

According to Conrad Bock (2003) an activity diagram clarifies the exact activities that occur and how the organization interacts with the system. In the following page is an activity diagram of the existing system.

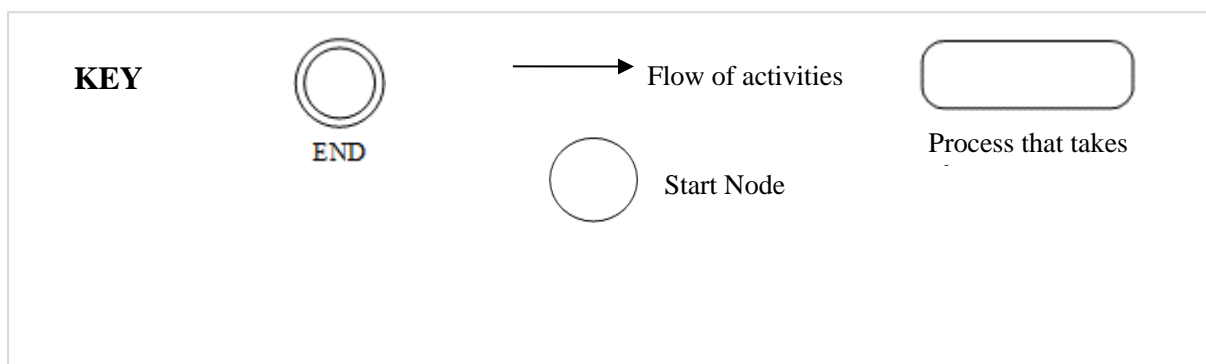


Fig 3.4.11 Key for activity diagram of current system

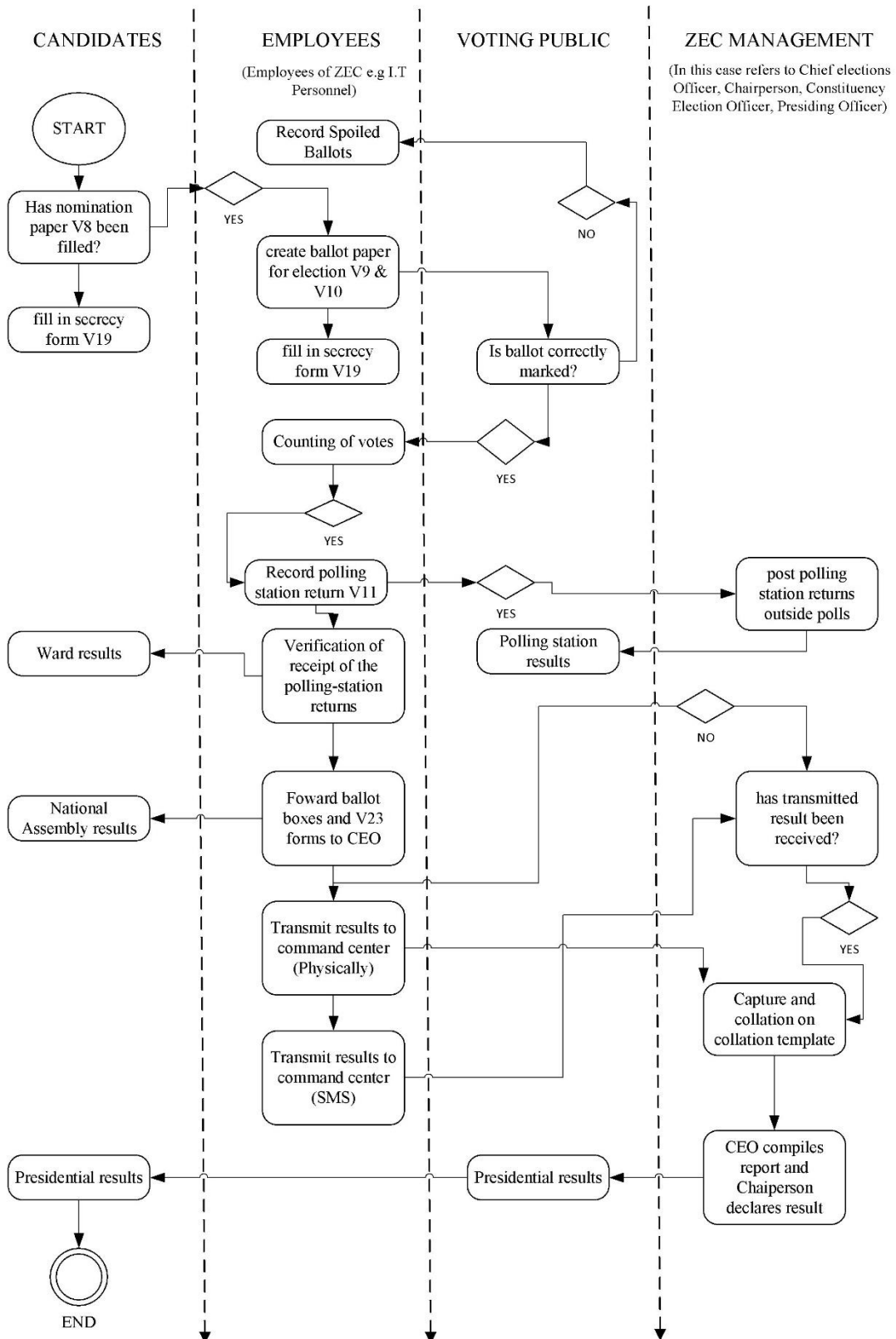


Fig 3.42 Activity diagram for the current system

3.5 Data Analysis

In their best-selling textbook *Qualitative Data Analysis*, Miles and Huberman (1994) describe data analysis as process of evaluating data using analytical and logical reasoning to examine each component of the data provided. This form of analysis is just one of the many steps that must be completed when conducting a research experiment

3.5.1 Context Diagram and DFD of the Existing System

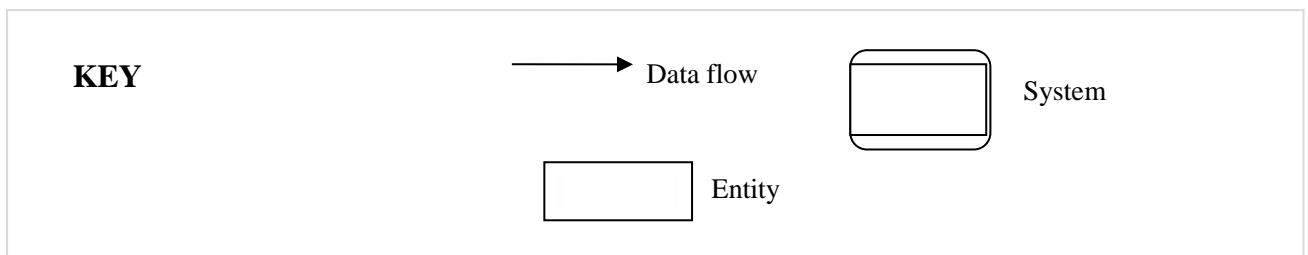


Fig 3.3 Key for Context Diagram of the Existing System

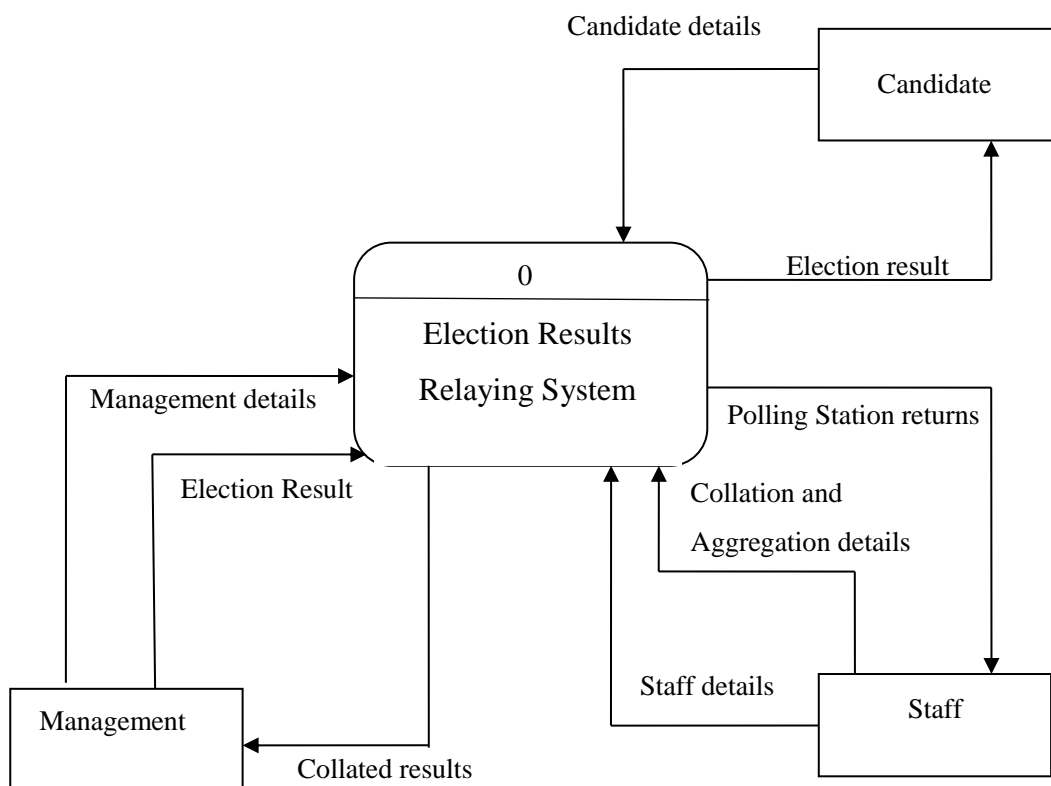


Fig 3.4 Context Diagram of the Existing System

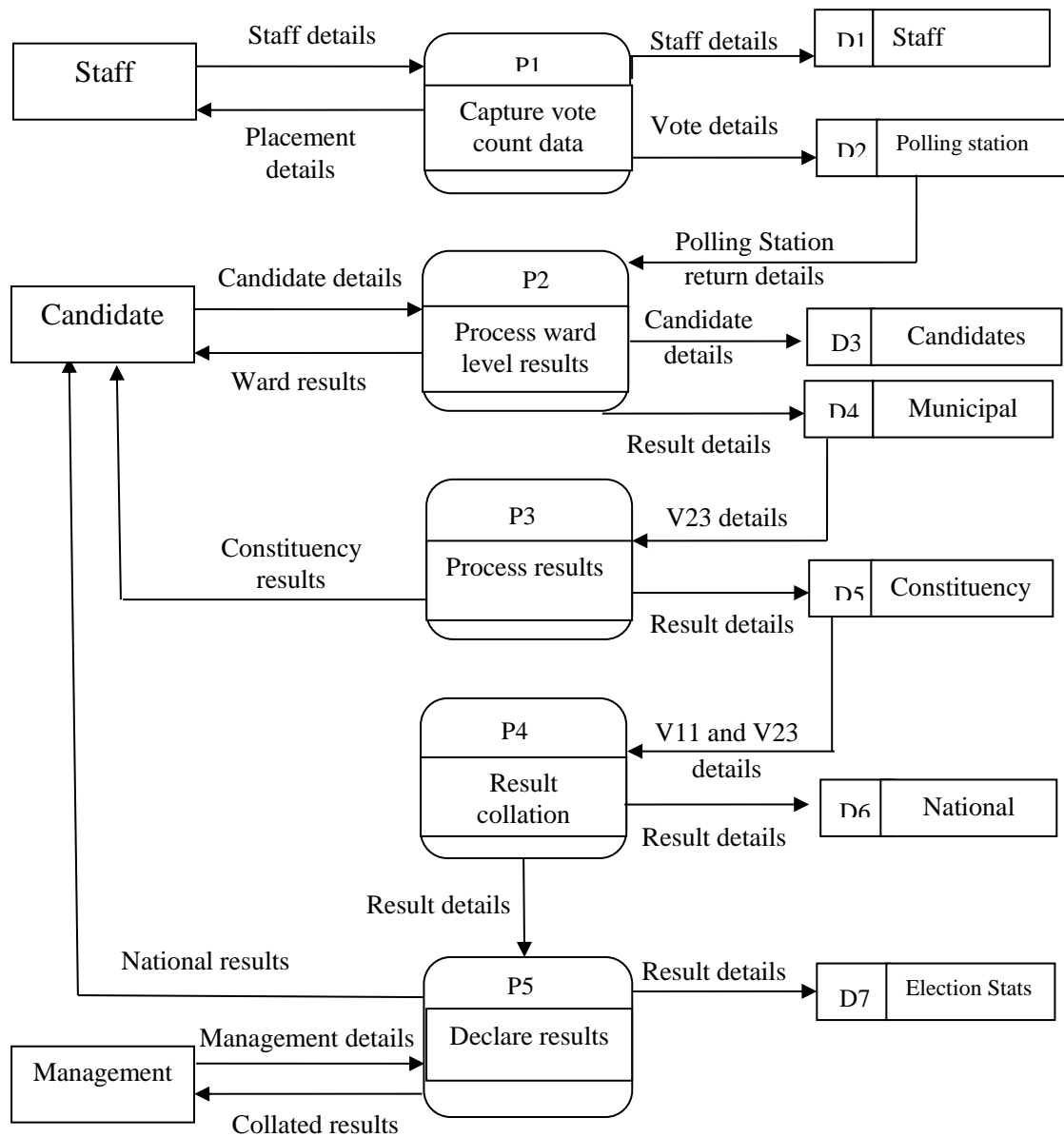


Fig 3.5 Data Flow Diagram of the Existing System

3.6 Weaknesses of current system

The researcher has listed in the following page weakness with the current ZEC results relaying system.

- The current system is susceptible to a higher probability of counting and calculation errors due to fatigue or gross negligence of the election persware involved in the result aggregation and collation process.
- With the current manual system there is a considerable delay and security risk in the relaying of results to the various command Centre's.
- The current system has a considerably high election organizing cost overhead. Results transmission success hinges on the timely procurement of relevant materials which make the process very costly.
- There is need for an automated system to complement the fax system of transmitting results and the Excel based aggregation template system used in the current setup.
- Currently the system has no way to ensure that results tally with the number of voters registered within a particular polling station, ward and constituency as no queries can be made to a manual voter registration database.

3.7 Evaluation of Alternatives

In order to come up with the best alternative to use the researcher will evaluate three possible routes ZEC can take in developing the proposed system. All the methods from which the researcher will choose from have their advantages and disadvantages and it is important to weigh out the best possible method to use that will suit ZEC's organizational interest.

3.7.1 Outsourcing

Outsourcing involves seeking outside support in some cases subcontracting resources to develop a project (Ebert, 2011). Outsourcing not only refers to skills and resources but an entire completed software solution can be outsourced. In relation to ZEC it will mean purchasing an already completed election results relaying system from a software vendor or hiring developers to come in and develop the system. This alternative has its pros and cons and these are noted in the following page.

Advantages	Disadvantages
1. The experience of the vendor in the system development will reduce risks.	There is increased training costs due to constant reference to developers for training
2. It requires less time to implement	Maintenance of the system will be the most difficult part because the IT department will not be the one who will have developed it so they will need external maintenance increasing the costs
3. There will be continuous improvements on user request since the users will be paying license and maintenance fees.	Due to one size fits all software's it will be difficult to customize the system
	If you have problems you are usually at the mercy of a large and faceless organization who may not be quite as concerned as you are if you have a major problem that absolutely MUST be fixed early.
	You may have to alter the way that you work in order to fit in with the way that the software has been designed

Table 11.3 - Advantages and disadvantages of outsourcing

From accessing the disadvantages over the advantages it is quite clear that ZEC should refrain from outsourcing such software especially considering the national importance of relaying results efficiently.

3.7.2 Improvement

Improvement encompasses the advancement of processes and procedures in the current manual system such that the system conforms to the newly set objectives. The feasibility of this alternative hinges on the number of computerized processes that are already in place, this is important as it is easier to improve a computerized system than a manual one. An assessment on whether ZEC should improve or not will be assisted by the pros and cons listed in the following table.

Advantages	Disadvantages
1. Expenditures and development time are reduced.	The same problems will continuously be faced as the system will still be manual
2. Upgrading the manual system will make life easier for the employees as they already know what they will be dealing with so no training is required	There is need to hire new employees so as to help because of the workload that is currently available, this will increase cost to the company
	Storage space will gradually become a problem as the current system resorts to manually filling its documents and physically moving ballots.
	Loss of data is bound to happen as data will be manually filed as well as well as unforeseen accidents that can affect ballot boxes in transit.

Table 12 - Advantages and disadvantages of improvement

Analysis of the disadvantages over the advantages gives an undeniable consensus on why ZEC should not use improvement as an alternative to develop this system.

3.7.3 In-House Development

In-house development entails the design of a software system by an organization using only internally sourced resources (Biafore and Stover, 2012). In-house development ensures that an organization uses only resources that are on hand and thereby reducing costs incurred using other alternatives. It is important to note that this method facilitates the development of a true custom made solution to fit into the organisation's processes. This is mainly because, a direct contact between the software team and the system users ensures a higher degree of successfully meeting user requirements. To best highlight the benefit a similar analysis as done with the other alternatives will be employed in the form of a table. The following page shows the advantages and disadvantages of in-house development.

Advantages	Disadvantages
1. There is control of the system as the company is not controlled by any third part that regulates the company on what to and what not to do	If you pick the wrong developer you could end up with an application that is unstable, unreliable and full of bugs (but then again so is some packaged software!). Selecting a developer who works to Best Practice and industry standards should counteract this.
2. It can be customised to interface with other software that you operate with the potential to provide you with a fully integrated IT infrastructure across your whole organisation	Developments costs are not clear until the end of the development thereby causing the company not to know how much to budget for the project
3. There will be continuous improvements on user request since the users will be paying license and maintenance fees.	
4. Users will usually find it easier and more intuitive to use as it should not contain unnecessary or superfluous facilities and should operate in the way that they are used to working	
5. It is much more flexible than packaged software and can be modified and changed over time as your requirements and business practices change	

Table 13 - Advantages and disadvantages of In-House Development

3.7.4 Evaluation of Alternatives Cost Analysis

To conclude on what route the researcher and ZEC should take in regards to type of alternative chosen a cost analysis will be done. Using Figs from the previous chapter for in-house development which was set at \$ 2 650, the other alternative Figs will be

estimated using actual market Figs. From the table we can justify the need for developing the ZEC system in-house.

ALTERNATIVES	SUMMARIZED COSTS
In-house development	\$ 13 000 (Value from chapter two)
Outsourcing the software	\$ 250 500 (Lowest prized outsourced software)
Improving the current system	\$ 35 000 (Estimate)

Table 14 - Evaluation of Alternatives Cost Analysis table

3.8 Requirements Analysis

Sommerville,(1998) define requirements analysis as an all-encompassing part of systems and software development that takes into account the tasks that result in the design of a system. Most authors site the importance of requirements as being critical to the overall success or failure of software development projects. The main aim of this analysis is to address the identified weaknesses of the current ZEC results relaying system.

3.8.1 Functional Requirements

According to Stellman et.al, (2005), functional requirements define exactly the accomplishments supposed to be achieved by a system, and these include calculations and technical details among other things. Use case diagrams are used to describe the instances where the system makes use of functional requirements. The proposed ZEC system should perform the following tasks as minimum functional requirements

- It should be able to facilitate the transmission of election results from the various polling stations throughout the country to the national command centre
- Should enable efficient and effective aggregation of election results from the ward command centres through to the national command centre.
- Should provide an authentication and verification platform for the source, counting and tabulating of election ballot papers and results.

- Should secure election results from hacking and manipulation as well as prevent fraud and voter privacy violation through the use of various access levels and generation of transaction history.
- Should allow verifiability, i.e. the system should permit access to any accredited persons to individually verify the results tally before transmission.
- Should ensure that results tally with the number of voters registered within a particular polling station, ward and constituency through queries with the voter registration database.
- Should provide efficient backup of data in order to eliminate the possibility of a single server crash paralyzing the entire election results process.

3.8.1.1 Use Case diagram

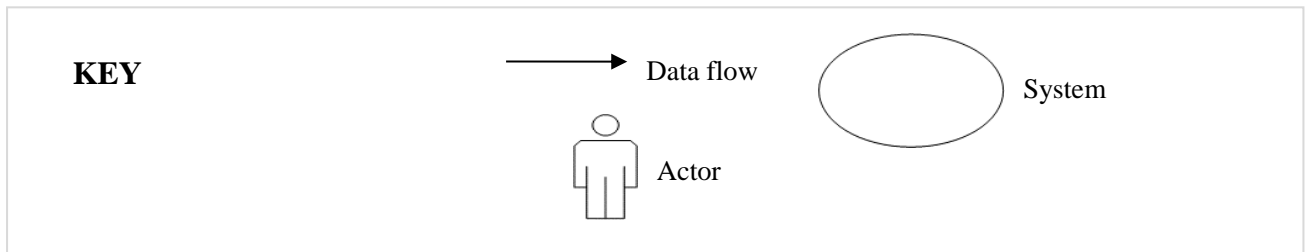


Fig 3.6 Key for USE CASE Diagram

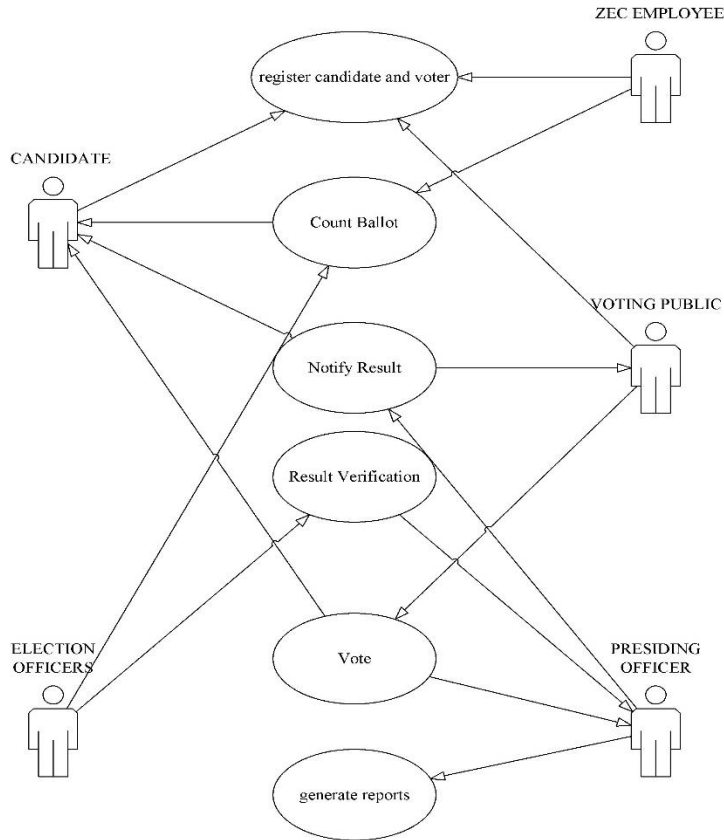


Fig 3.7 USE CASE Diagram

3.8.2 Non-functional requirements (outline constraints)

Leffingwell et.al, (2003) defined nonfunctional requirements also known as system qualities as the factors that describe the system. These factors include usability, security, scalability and reliability among a host of other factors. The researcher noted that non-functional requirements catered for all the requirements not covered by functional requirements.

3.8.2.1 Performance Requirements

- In terms of performance expectations are that the system will very responsive i.e. Users will not wait considerable time for processing. Expected waiting time is between 1-2 seconds during peak hours of system use.

3.8.2.2 Security Requirements

- For all data transactions made within the system between client machines and the server, use of encryption will be used to ensure no hacking techniques can be used to illegally obtain data during transmitting.
- The system is expected to encrypt user passwords using random cipher text to avoid intrusion. It will also not be possible for an individual to recover passwords, only the system will have this capacity.
- Depending on the type of election and year of election the system should not permit access to past users rather should request re-authentication.

3.8.2.3 Safety Requirements

- The system should help prevent data loss by employing fail safe mechanisms such as allowing data to be saved locally when the system is done and then updating when system is up again.
- Should include a profile where if security intrusions are detected the system can be completely shut down in an instance to prevent further data loss.
- Most importantly the system should recover from server crashes without any issues.

3.8.2.4 Reliability

- System should ensure that during the actual election it maintains no less than 80% reliability percentage via the use of system validations.
- To ensure correct Figs are worked with, the system should ensure that modified database data is updated instantly across all users.

3.9 Conclusion

This chapter looked to provide a clear explanation of the current problems and objectives. It also looked at the information gathering methodologies that were employed to analyze the current system so as to point out the weaknesses against the strengths. The Researcher will now proceed with in-house system development and look at system design in the following chapter.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

The last chapter provided a clear explanation of the current problems and objectives. It also looked at the information gathering methodologies that were employed to analyze the current system pointing out the weaknesses against the strengths. In this chapter the researcher will look to convert the logical system into actual physical design.

4.2 System Design

Whitten, (2004), identified system design as the development of a software package to solve current system problems as well as meeting user requirements. The fundamental undertakings in system design and development consist of developing system-level technical requirements, top-level system designs and assessing the design's ability to meet the system requirements.

4.2.1 Description of the proposed system

The researcher is proposing an electronic election results relaying system that will function in the following way:

- The system will make use of source documents that are the inputs in the current manual system. These forms include the V11 and V23 among other input documents. The main aim of the system is to facilitate the transmission of election results from the various polling stations throughout the country to the national command centre
- Instead of having certain individuals tally forms from the polling stations which is sometimes prone to miscalculation errors the system will enable efficient and effective aggregation of election results from the ward command centres through to the national command centre.
- Once polling station returns data has been entered into the system. All the calculations will automatically be done by the system once verification takes place. In other words the system will provide an authentication and verification platform for the source, counting and tabulating of election ballot papers and results.
- In terms of security the system will provide a secure platform to prevent election results from hacking and manipulation as well as prevent fraud and voter privacy violation .To

achieve this the system will employ various access levels and generation of transaction history in addition to the encryption of data.

- As a way to make sure that that results tally with the number of voters registered within a particular polling station, ward and constituency. The system will make automated queries to the voter registration database.
- The proposed system will provide efficient backup of data in order to eliminate the possibility of a single server crash paralyzing the entire election results process. This is an automated capability that will be designed by the researcher by making use of timestamps.

4.2.2 Context diagram and DFD of the proposed system

According to Kossiakoff and Sweet (2011) context diagrams demonstrate how the system as a whole functions including the inputs and outputs. They also defined data flow diagrams as representations of processed and data flow to and from entities as well as the data stores involved.

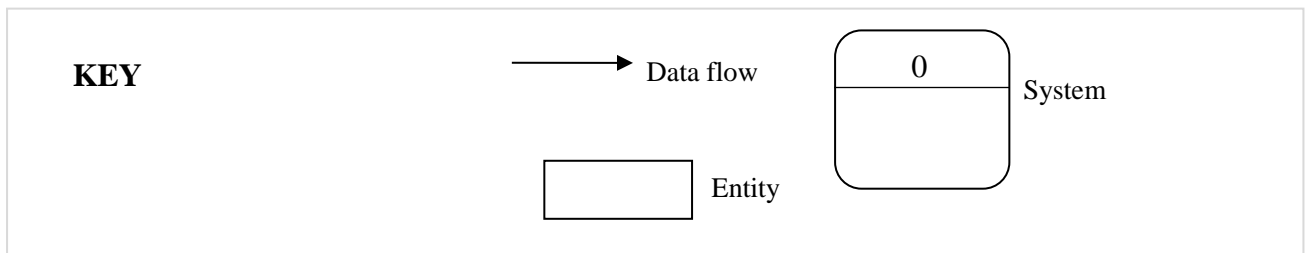


Fig 4.1 Key for context diagram of the proposed system

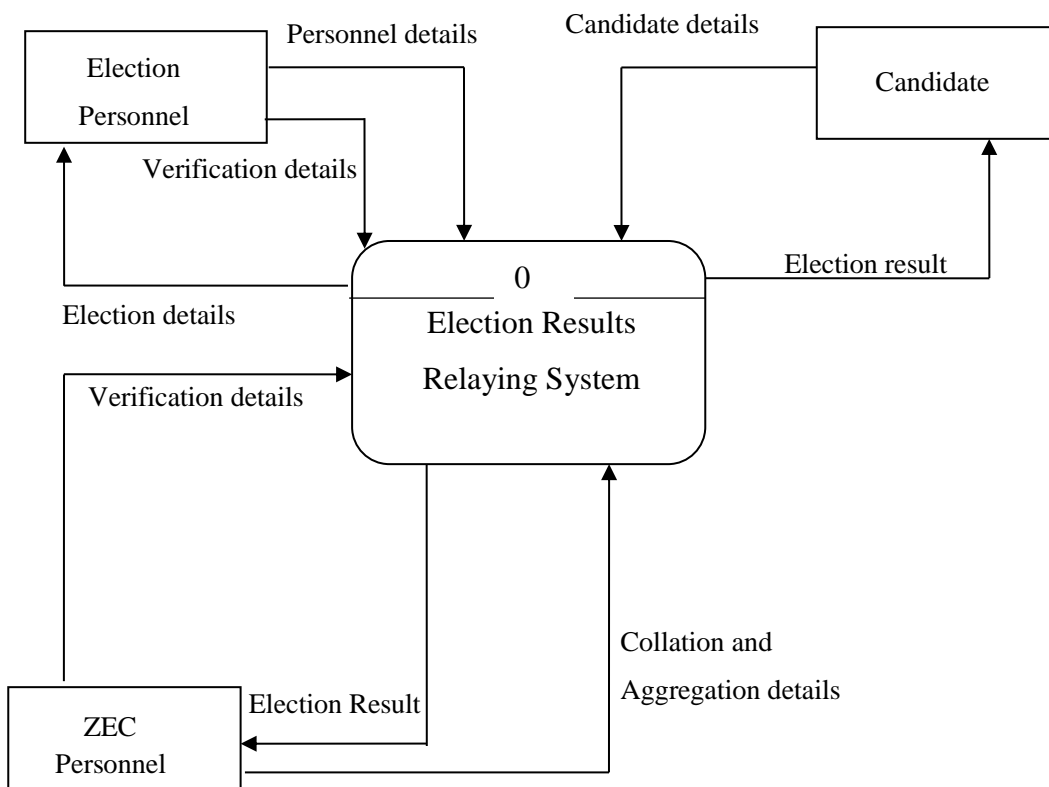


Fig 4.2 Context diagram of the proposed system

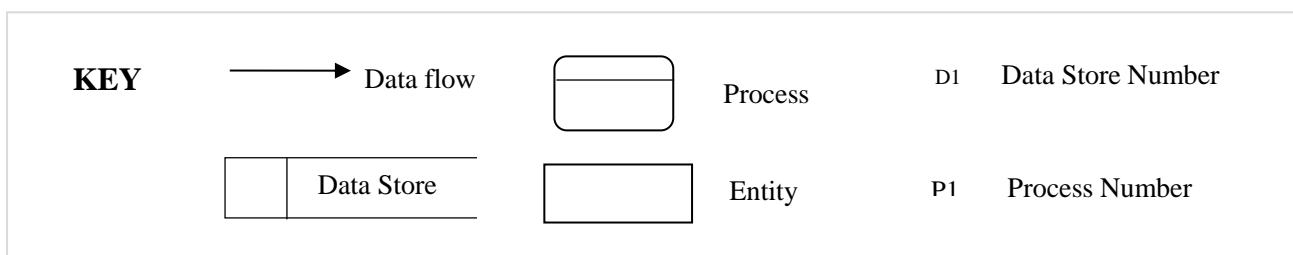


Fig 4.3 Key for data flow diagram of the proposed system

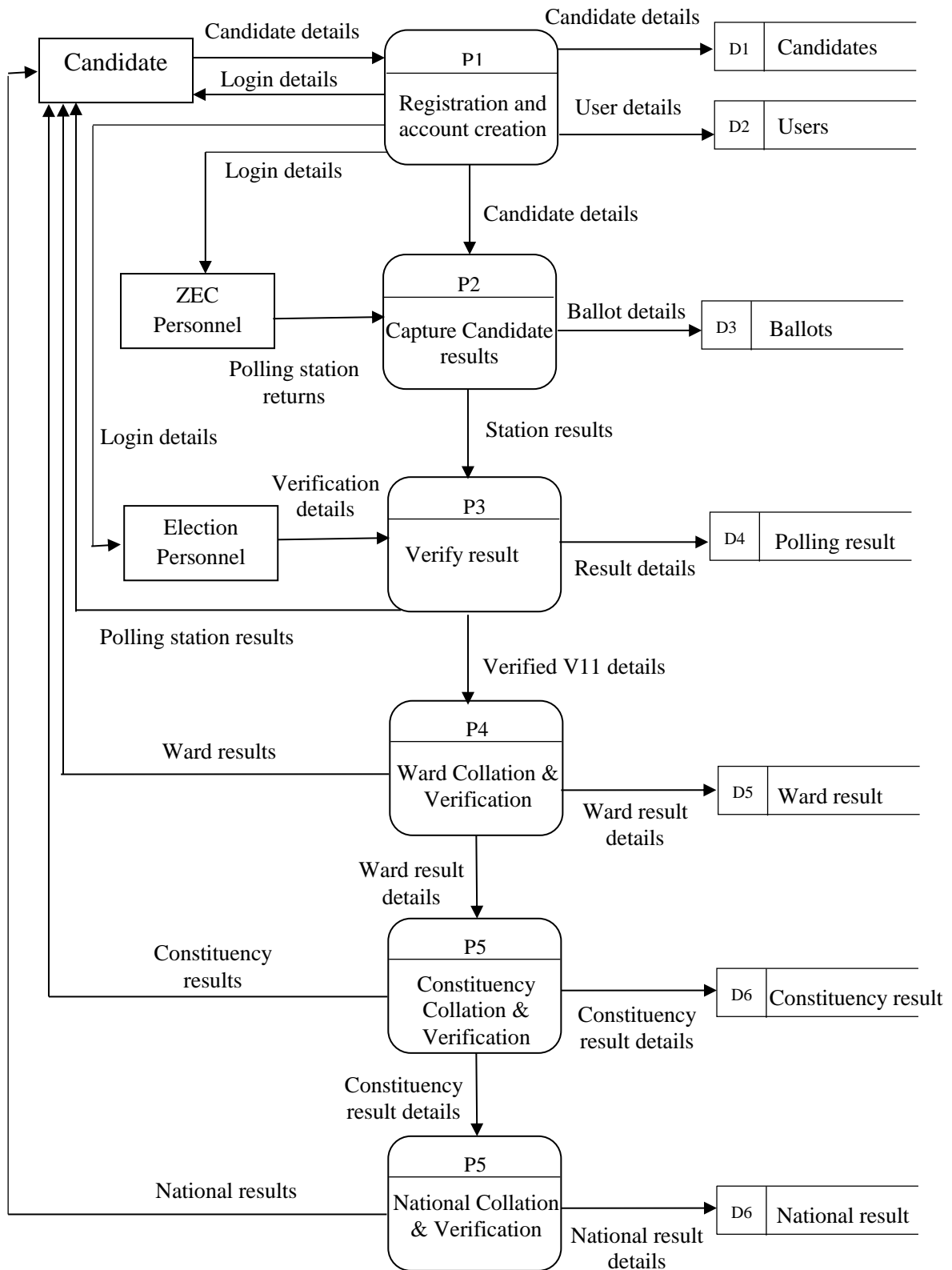


Fig 4.4 Data flow diagram of the proposed system

4.3 Architectural design

Reitman et.al (2010) derived and refined an earlier definition of architecture design based on work by (Shaw and Garlan 1996). They defined architectural design as a process that takes system modules and merging them into a coherent and efficient system. Below is a proposed diagram of the system architectural design.

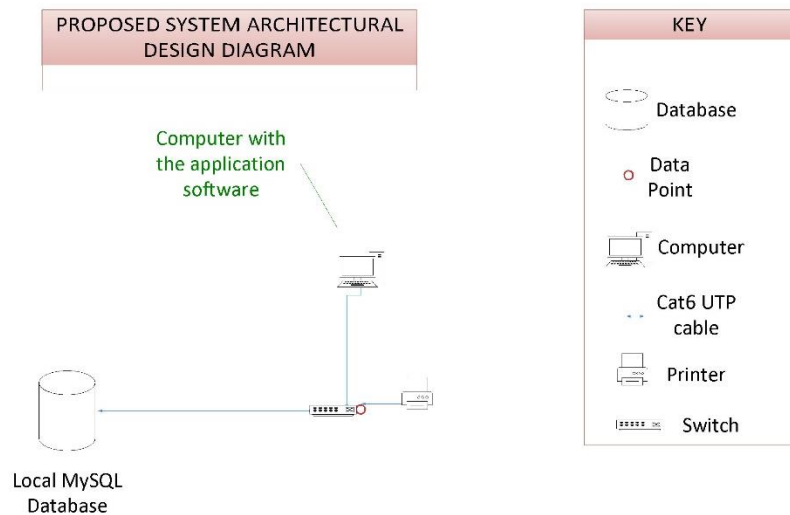


Fig 4.5 Architectural design of the proposed system

4.4 Physical design

Reitman et.al (2010) also define physical design as a process through which conversion from gathered data from logical design to incisive descriptions of the physical layout.

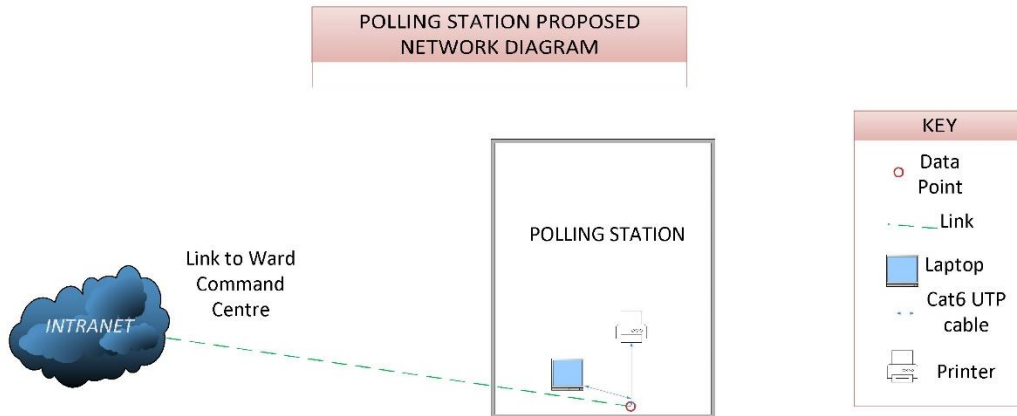


Fig 4.6 Proposed polling station network diagram

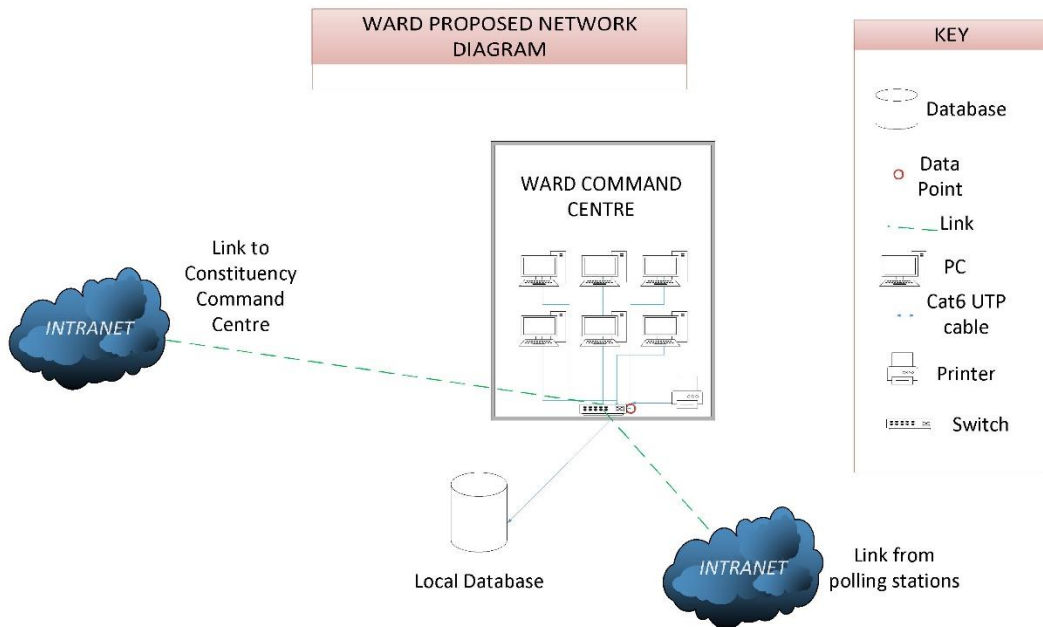


Fig 4.7 Proposed ward network diagram

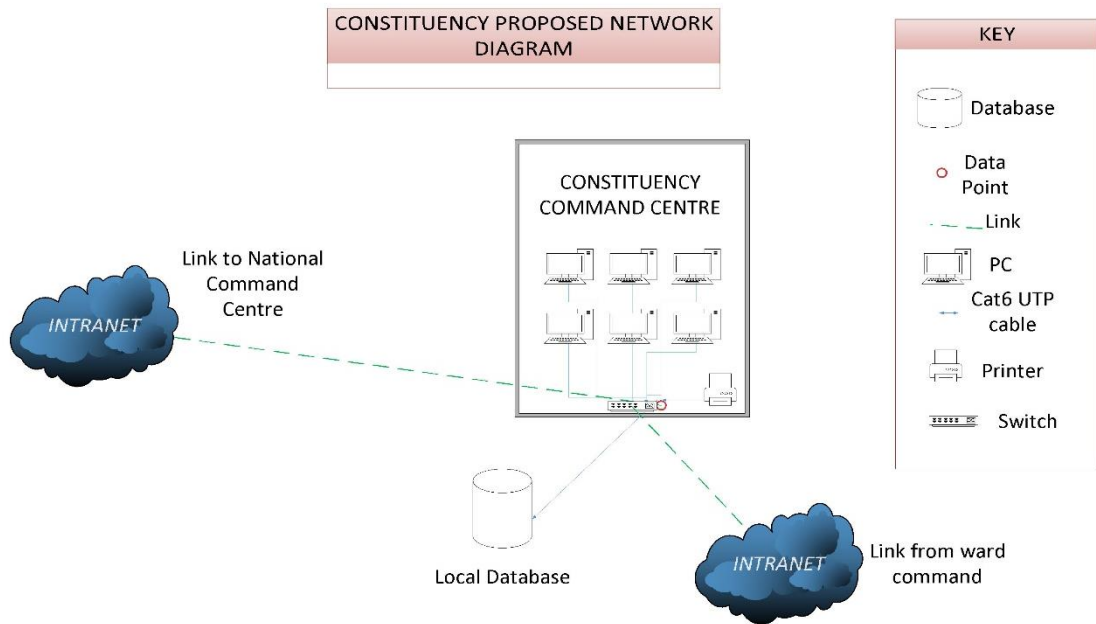


Fig 4.8 Proposed constituency network diagram

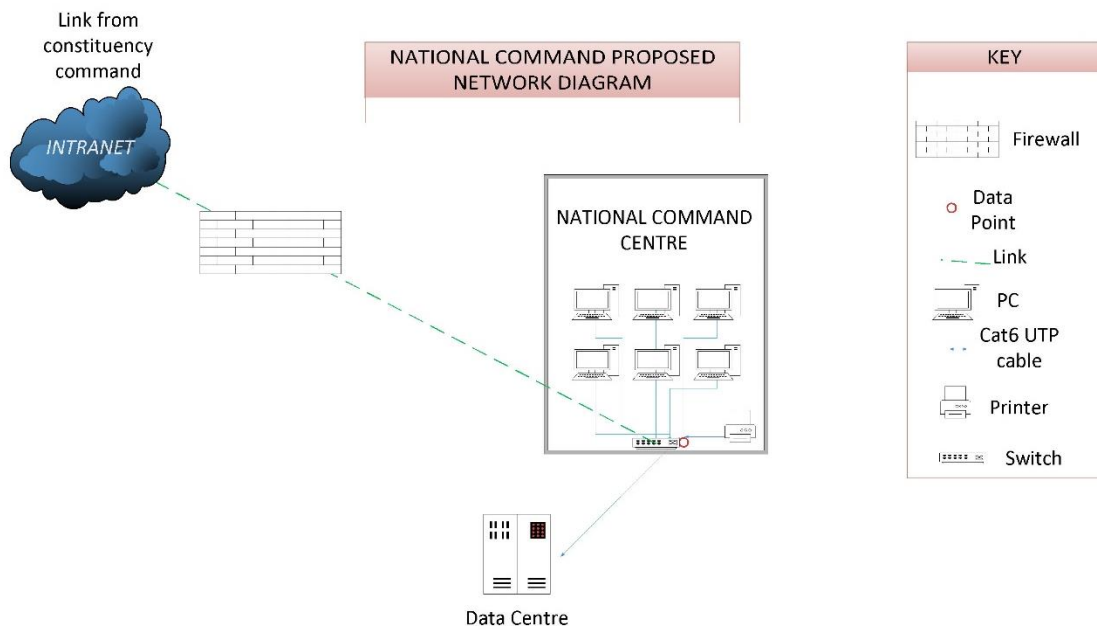


Fig 4.9 Proposed national command network diagram

4.5 Database design

It is a technique of generating a data model of the proposed database that is comprehensive and well detailed (Stephens, 2010). The proposed database should ensure various factors that include data security, data integrity and also data consistency to ensure the database always remains in a consistent state before and after transactions.

The following are the tables that will be designed for the ZEC elections results relaying system, although subsequent changes will be made the researcher undertakes development.

4.5.1 Tables Structure

Table: user_table

Primary Key: username

Field	Data Type	Constraints
User_Name	Char(15)	Primary key
User_Role	Number(9)	Not null
Password	Char(15)	Not null
Email_address	Char(30)	Not null
Surname	Char(30)	Not null
Forename	Char(30)	Not null
Phone_Number	Char(30)	Not null
Designation	Char(30)	Not null

Table 4.1 User database table

Table: transactions_table

Primary Key: Serial_number

Field	Data Type	Constraints
Serial_Number	varchar	Primary key
Captured_By	varchar	Not null
Capture_Date	varchar	Not null
Capture_Time	varchar	Not null
Verified_By	varchar	Not null
Verify_Date	varchar	Not null
Verify_time	varchar	Not null

Table 4.2 transactions database table

Table: station_details_table

Primary key : Station_code

Field	Data Type	Constraints
Station_Code	varchar	Primary key
province	varchar	Not null
district	varchar	Not null
constituency	varchar	Not null
local_authourity	varchar	Not null
ward_number	varchar	Not null
polling_station	varchar	Not null
facility	varchar	Not null

Table 4.3 station details database table

Table: registration_table

Primary Key: Serial_Number

*will be used to query if vote count tallies with number of registered voters in a polling station

Field	Data Type	Constraints
Serial_Number	varchar	Primary key
ID_Number	varchar	Foreign key
Surname	varchar	Not null
Forename	varchar	Not null
DOB	varchar	Not null
Sex	char	Not null
Address_Number	varchar	Not null
Address_Name	varchar	Not null
Address_Location	varchar	Not null
Address_Area	varchar	Not null
Phone_Number	varchar	Not null
Email_Address	varchar	Not null
Disability_Code	varchar	Not null
Date_Of_Registration	varchar	Not null
Date_Of_Capture	varchar	Not null
Station_Code	varchar	Not null
Registration_Centre	varchar	Not null
Verification_Status	varchar	Not null
Life_Status	varchar	Not null
Full_Address	varchar	Not null
Registration_Officer	varchar	Not null
Officer_ID	varchar	Not null
Flag	varchar	Not null
ID_Number	varchar	Not null

Table 4.4 registration details database table

Table: logtransactions_table

Composite Key: loginTime, user_Name

Field	Data Type	Size	Constraints
loginDate	varchar	25	Not Null
loginTime	varchar	25	Primary Key
logoutDate	varchar	25	Not Null
logoutTime	varchar	25	Not Null
user_Name	varchar	25	Primary Key
Mac_address	varchar	20	Not null

Table 4.5 log transactions database table

Table: ballot_table

Primary Key: ballot_id

Field	Data Type	Constraints
ballot_id	Number(9)	Primary key
ballot_date	Date	Not null
ballot_code_range	Numeric (100)	Not null
ballot_count	Numeric (100)	Not null
Spoiled ballots	Numeric (100)	Not null
unaccounted	Numeric (100)	Not null
unused	Numeric (100)	Not null
Station code	Varchar (30)	Not null
Presiding officer	Varchar (30)	Not null

Table 4.6 ballot database table

Table: result_table

Primary Key: result_code

Field	Data Type	Constraints
result_code	Numeric (10)	Primary key
result_type	Varchar (20)	Not null
Vote count	Numeric (100)	Not null
party	Varchar (20)	Not null
Candidate id	Varchar (20)	Foreign key
Result date	Varchar (20)	Not null
Election officer	Varchar (20)	Not null

Table 4.7 results database table

Table: candidate_table
Primary Key: candidate_id

Field	Data Type	Constraints
Candidate_id	Numeric(9)	Primary key
Surname	Varchar (20)	Not null
Forename	Varchar (20)	Not null
DOB	Varchar (20)	Not null
Sex	Varchar (20)	Not null
Address_Number	Varchar (20)	Not null
Address_Name	Varchar (20)	Not null
Address_Location	Varchar (20)	Not null
Address_Area	Numeric (500)	Not null
Phone_Number	Varchar (30)	Not null
Email_Address	Char (20)	Not null
Date_Of_Registration	date	Not null
Date_Of_Capture	Varchar (20)	Not null
Station_Code	Varchar (20)	Not null
Registration_Centre	Varchar (20)	Not null
Verification_Status	Varchar (20)	Not null
Election_year	date	Not null

Table 4.8 candidate’s database table

4.5.2 ER Diagram

This is the diagram in database design that illustrates entities contained in proposed system. They help show the various relationships amongst these entities (Sommerville, 2008). The researcher will show the various system entities of the proposed system in the following page through the use of an entity relationship diagram.

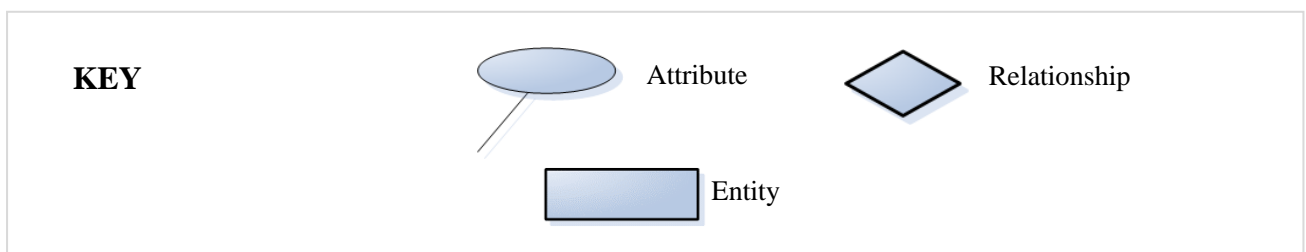


Fig 4.10 Key for enhanced entity diagram

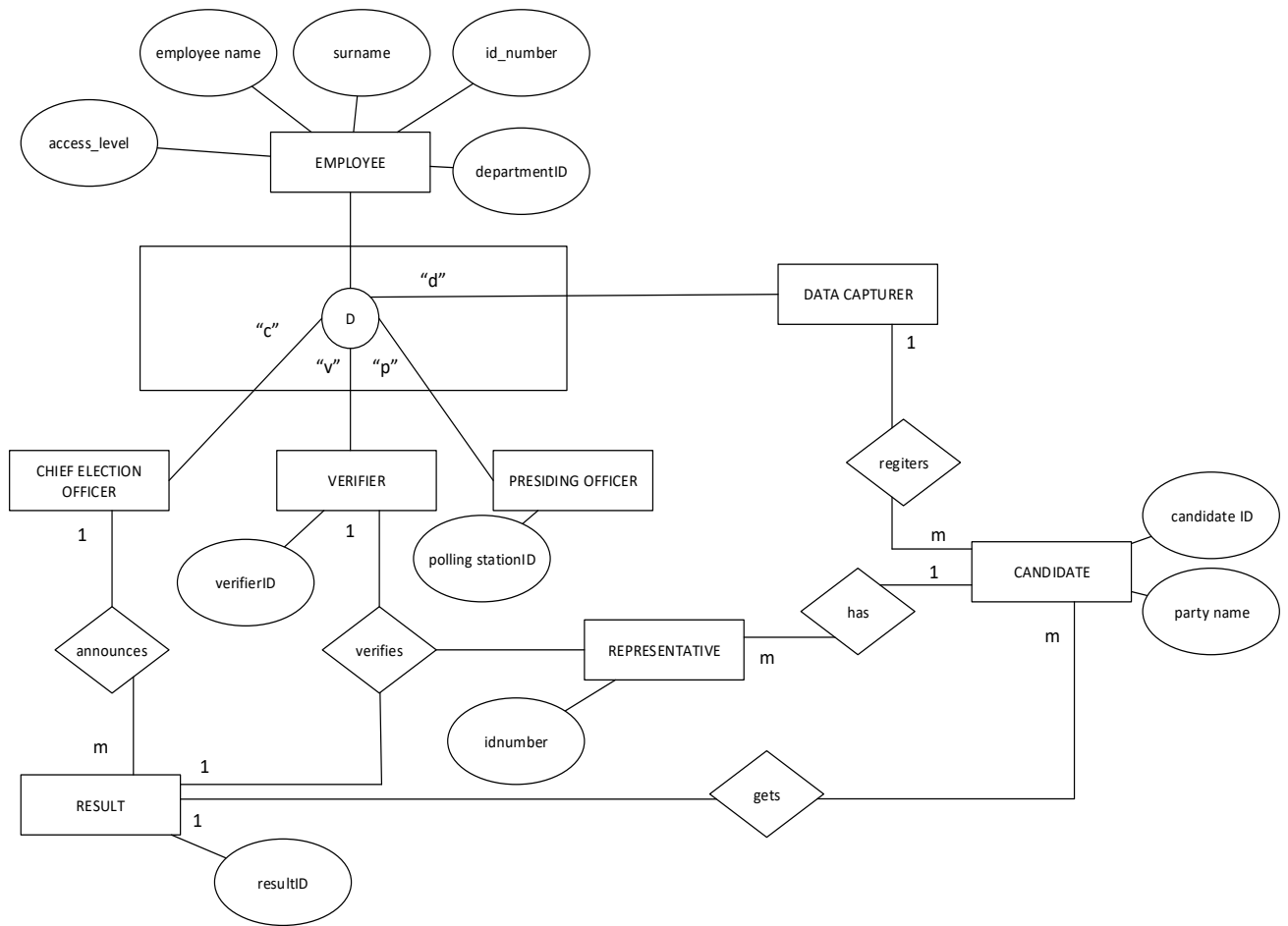


Fig 4.10: EER diagram for the proposed system

4.6 Program design

According to Wand, (2009), **program design** is the action of systematic progression from a design of a certain software package to an explanation of the software package itself. Program design can be viewed as a process and also a model.

4.6.1 Package Diagram

Keyes, (2011) defines package diagrams as representations of system modules and system elements of an organization. Below the researcher will highlight the various system modules that will be in the system.

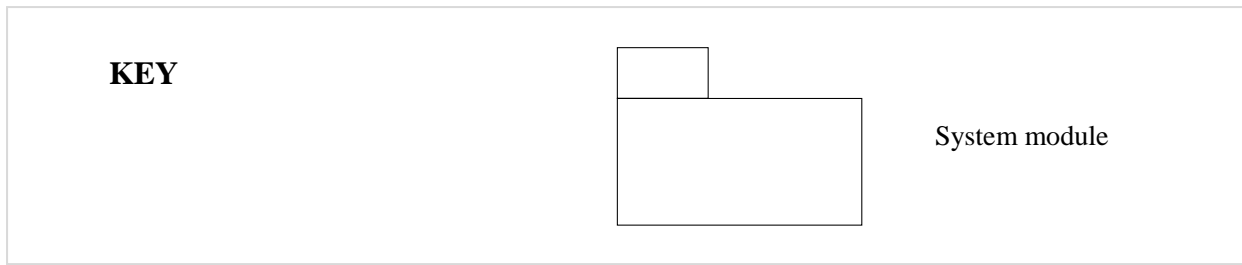


Fig 4.12 Key for package diagram of the proposed system

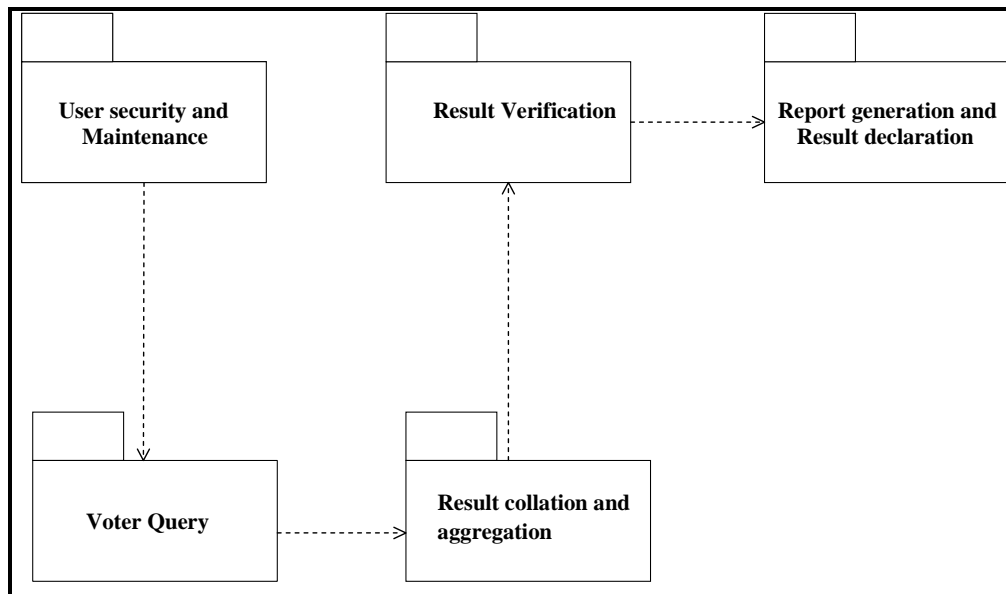


Fig 4.13: Package diagram for the proposed system

4.6.2 Class diagram

Favre, (2003) cited class diagrams as mere representations of the actual sphere. He goes on to recommend the use of data integrity in class diagrams to show the various relationships between interacting entities. All the various relationships highlighted in an entity diagram should be shown in the class diagram along with the attributes and operations performed by the classes.

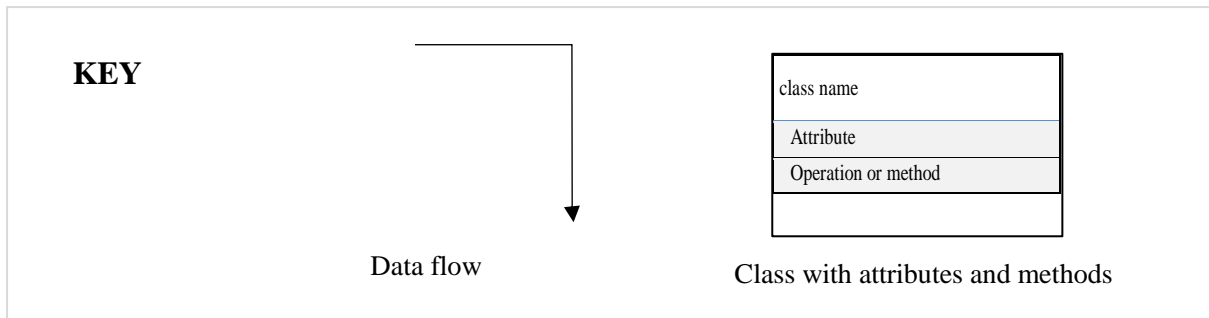


Fig 4.14: Key for class diagram for the proposed system

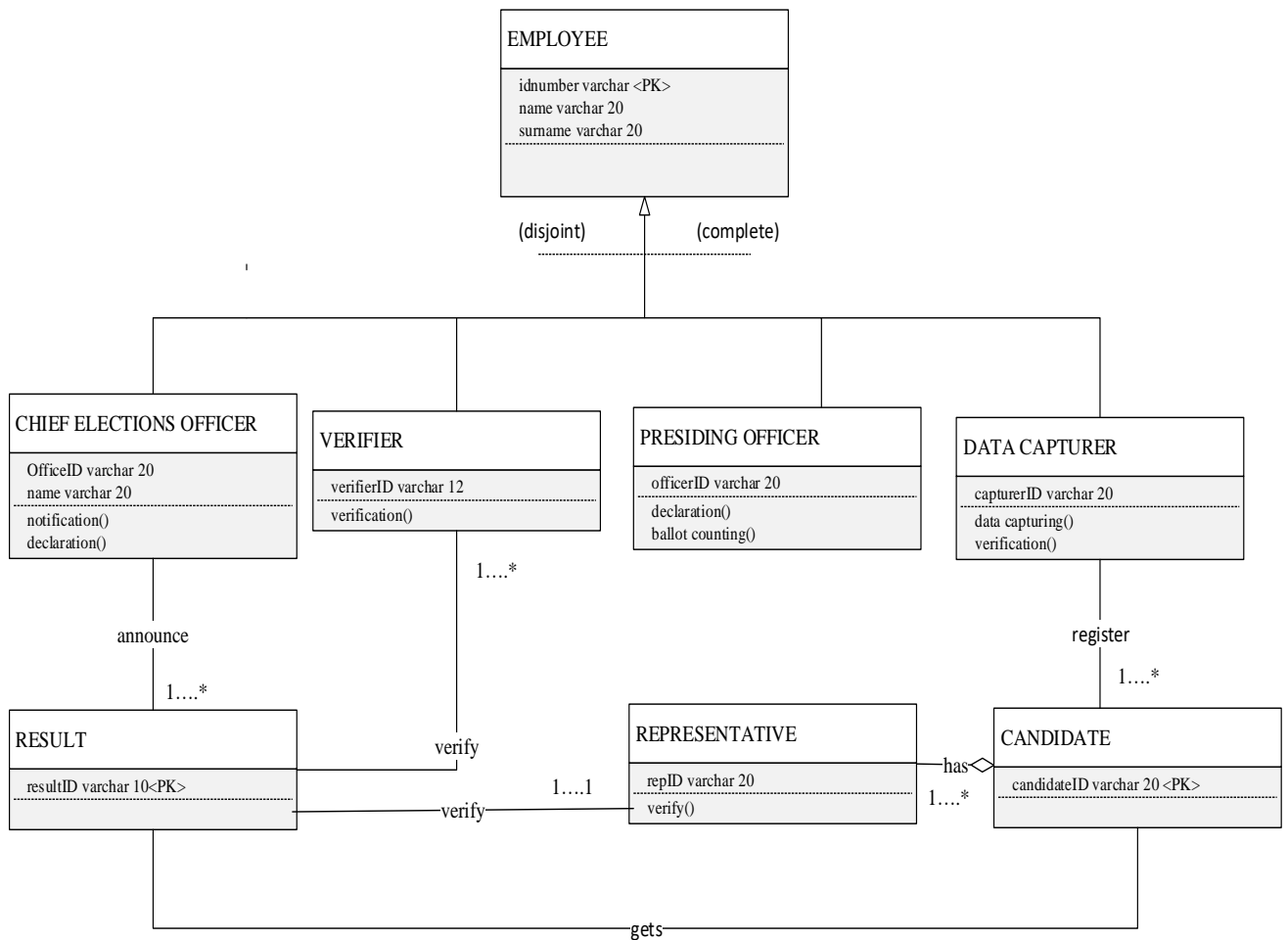


Fig 4.15: class diagram for the proposed system

4.6.3 Sequence diagram

A Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order (Rumbaugh, 2010). In the following page shows a sequence diagram of the proposed system.

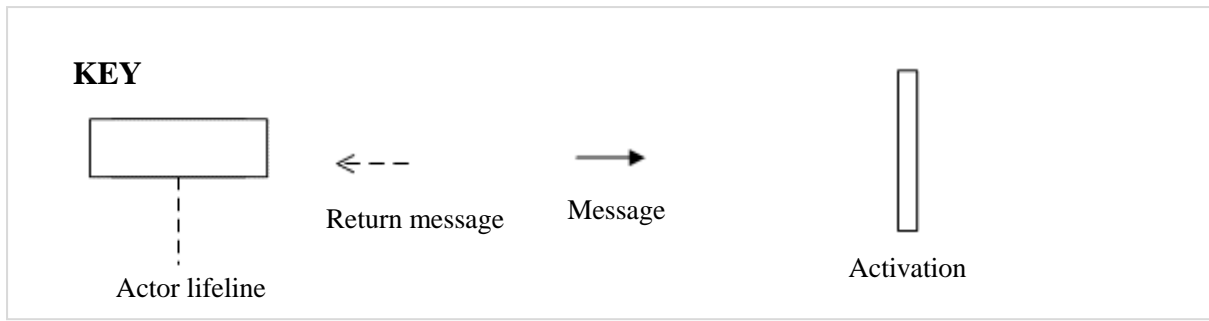


Fig 4.16: Key for sequence diagram for the proposed system

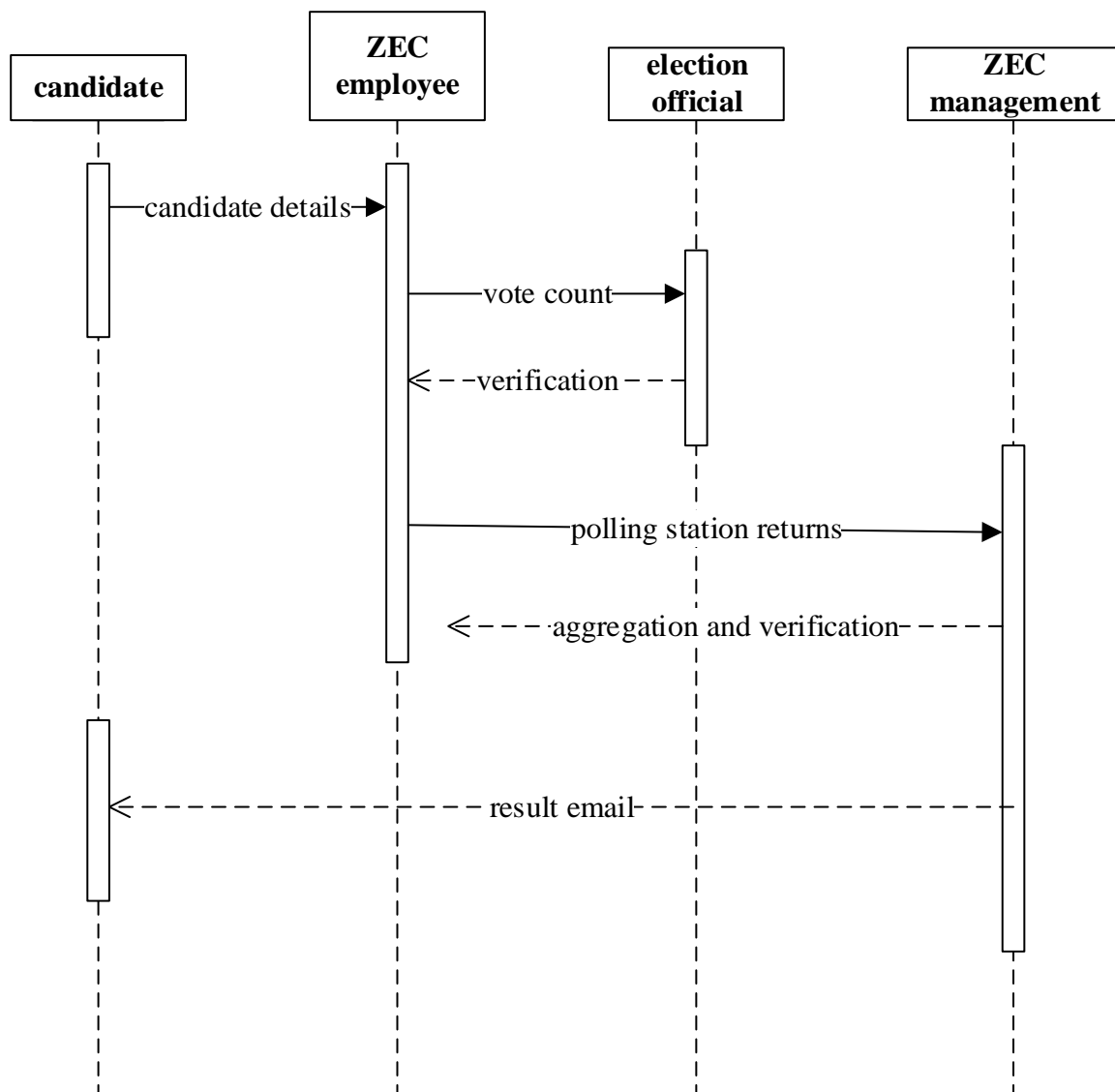


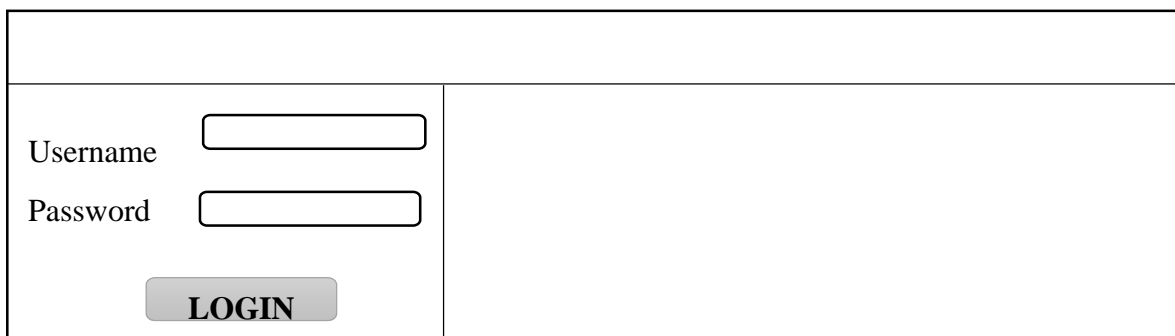
Fig 4.17: sequence diagram for the proposed system

4.7 Interface design

In the Humane Interface a book by Jef Raskin , the author points out two important laws when designing a user interface. The first law is to design a user interface that that will not in any way distract the users' attention. The second law is to design interfaces that do not cause delays to the users work. The interface design is usually referred to as the graphical user interface through which the user of a system interacts with the various system components.

4.7.1 Main menu

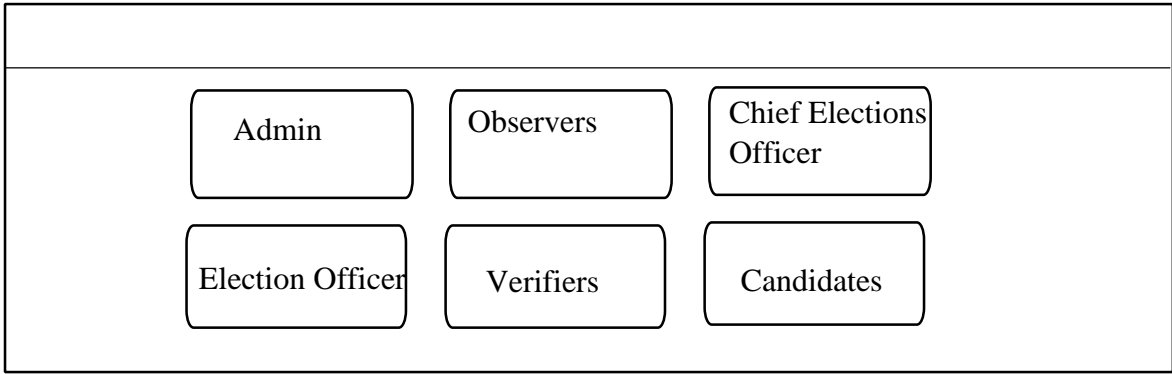
In order to access the main menu users will first have to go through the login page shown below. This form will be the systems' first line of defense in restricting unauthorized access to the system



The image shows a login form within a rectangular border. On the left side, there are two input fields: the top one is labeled 'Username' and the bottom one is labeled 'Password'. Below these fields is a button with the text 'LOGIN' in bold, uppercase letters. The right side of the form is empty.

Fig 4.18: login form for the proposed system

The following page shows the form that will contain submenus which will link to input and output forms related to the various menus. The system will have at least six submenus that will include admin, observers, chief elections officer, verifiers', candidates and election officers among other sub menus that will be added.



:

Fig 4.19: sequence diagram for the proposed system

4.7.2 Input design (Include all input forms in the system)

The input design will incorporate the forms prescribed in the statutory instrument 21 of 2005 as the official data capture layout of ZEC forms. All the forms will be used as they are, citing legal implications if the researcher decides to design completely new forms.

Form V.19

ELECTORAL ACT [CHAPTER 2:13]

PARLIAMENTARY AND PRESIDENTIAL ELECTIONS: DECLARATION OF SECRECY

I,
(full names in block letters)

being duly appointed as a

(here insert "Constituency elections officer", Deputy Constituency elections officer", "Assistant Constituency elections officer", "Presiding Officer", "Candidate" or "Candidate's Agent", as the case may be) do solemnly promise and declare that I will not, at this election of a member of Parliament of Zimbabwe for the constituency of, do anything forbidden by sections 86 and 87 of the Electoral Act [Chapter 2:13], which sections I have read.

(Signed)

Address

Date, 20

The above declaration was made and subscribed before me this day of, 20....., by the declarant, after having read sections 86 and 87 of the Electoral Act[Chapter 2:13].

Place

Date, 20

(Signed)

Constituency elections officer or
Commissioner of Oaths

Fig 4.20 V19 form (source statutory Instrument 21 of 2005)

The declaration of secrecy required by section 82 of the Act shall be in form V.19 for Parliamentary and Presidential elections.

ELECTORAL ACT [CHAPTER 2:13]
(Section 46(1))

NOMINATION FORM: MEMBER OF PARLIAMENT

NOTE: Aspiring candidate should produce:

1. a birth certificate together with National Registration Identity Card. Please attach photocopies of the said documents.
2. a passport-size black and white photograph.

We, the undersigned voters registered in the
constituency, hereby nominate:

..... I/D No.
(full names in block letters)

of
(full address in block letters)

as a candidate for election to represent the said constituency in Parliament.

1. Full names

The V8 nomination paper for election as a Member of Parliament in terms of section 46 of the Act. Will be used to input details of the contesting candidates into the system.

(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

2. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

3. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

4. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

5. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

6. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

7. Full names
(Block letters)

National Registration No.

Signature Date.....

Signed in the presence of
(Candidate/Chief Election Agent/Authorized Representative)

8. Full names
(Block letters)

National Registration No.

(Candidate/Chief Election Agent/Authorized Representative)

Note.—Extra nominations may be made by attaching a separate sheet containing the same particulars and complying with same procedures as are here required of the minimum number of nominees.

DECLARATION BY OR ON BEHALF OF CANDIDATE

..... of
(full name of candidate, in block letters)

.....
(address of candidate date, in block letters)

Candidate's telephone No.

I certify that:

1. The candidate is enrolled as a voter in the constituency.
2. The candidate has been ordinarily resident in Zimbabwe for a period of not less than five years during the period of twenty years immediately preceding the date of this nomination-paper.
3. The candidate is not disqualified for election in terms of paragraph 2 of Schedule 3 to the Constitution.
4. Each of the persons nominating the candidate signed this nomination paper in the presence of the candidate or his or her chief election agent or his or her authorized representative.
5. The candidate accepts the nomination as a candidate for election to Parliament.

Date Signature
Candidate/Candidate's Chief
Election Agent

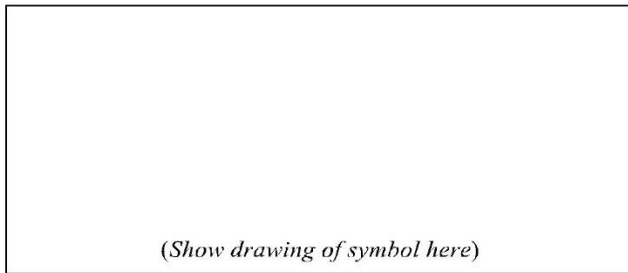
(FINAL PAGE)

DISTINCTIVE SYMBOL AND PARTY NAME AND ABBREVIATION

(This part is to be completed if the candidate wishes a distinctive symbol and/or Party identification to appear on the ballot)

1. Distinctive Symbol

The candidate wishes the following symbol to appear on the ballot paper in conjunction with his/her name:



Short description of symbol:
.....

2. Party Identification

The candidate will be standing for or be sponsored by the following party

.....
.....

(full name of Party in block letters)

and wishes the following abbreviation of the Party's name to appear on the ballot paper in conjunction with his/her name

(block letters)

Signature

Candidate/Candidate's Chief Election Agent**

3. *Party authorization* (to be completed by a duly authorized party official if the candidate has indicated that he/she wishes the abbreviation of a party's name to appear on the ballot paper in conjunction with his/her name)

I,

(full names)

being the

(state office held)

on the

(full name of political party)

and, as such, duly authorized in terms of the constitution of the party, certify that the candidate to whom this nomination paper relates will stand for, or be sponsored by, the party.

Date

.....

Signature

**Delete whichever does not apply*

Note: This form must be accompanied by a passport-sized black and white photograph of the candidate.

Fig 4.21 V8 form (source statutory Instrument 21 of 2005)

The presiding officer shall record the details of the counting on a polling station-return as shown in the following form V.11. Provided that when Parliamentary and Presidential elections coincide, the presiding officer shall complete two separate polling station returns in form V.11.

ELECTORAL ACT [CHAPTER 2:13]
(Sections 4(1) and 64)

PARLIAMENTARY AND PRESIDENTIAL ELECTIONS: POLLING-STATION RETURN					
Polling Station at:.....					
PART A: BALLOT PAPER ACCOUNT					
Ordinary ballot papers received	No.	Ordinary ballot papers accounted for	No.		
Nos. _____ to _____ inclusive		1. Ballot papers in ballot box..... 2. Ballot papers unused..... Nos. _____ to _____ inclusive 3. Ballot papers spoilt..... 4. Ballot papers unaccounted for...			
TOTAL		TOTAL			
Tendered ballot papers received	No.	Tendered ballot papers accounted for	No.		
Nos. _____ to _____ inclusive		1. Tendered ballot papers used.... 2. Tendered ballot papers unused..... Nos. _____ to _____ inclusive 3. Tendered ballot papers spoilt..... 4. Tendered ballot papers unaccounted for.....			
TOTAL		TOTAL			
I hereby certify that the above is a correct statement of all ballot papers received by me. (Signed)..... <i>Presiding Officer</i> Dated this..... day of....., 20.....					
PART B: RESULT OF COUNTING					
Names of candidates	Party /Independent	Votes received A-L	Votes received M	Votes received N-Z	Total valid votes received
1.					
2.					

3.					
4.					
5.					
6.					
		Votes rejected A-L	Votes rejected M	Votes rejected N-Z	Total votes rejected
					Total valid and rejected votes cast
<p>I hereby certify that the above is a correct statement of all votes counted at the abovementioned polling station</p> <p style="text-align: right;">(Signed).....</p> <p style="text-align: right;"><i>Presiding Officer</i></p> <p>Dated this..... day of....., 20.....</p> <p>Signatures of candidates/election agents (please specify designation opposite signature)</p> <p>(Signed).....</p> <p>(Signed).....</p> <p>(Signed).....</p> <p>(Signed).....</p> <p>(Signed).....</p> <p>(Signed).....</p>					

Fig 4.22 V11 form (source statutory Instrument 21 of 2005)

Form V. 23

ELECTORAL ACT [CHAPTER 2:13]
(Section 65)

PARLIAMENTARY AND PRESIDENTIAL ELECTIONS: COLLATION OF POLLING-STATION RETURNS AND ADDING TOGETHER OF ORDINARY AND POSTAL VOTES

Constituency..... Constituency Centre at:

No. of Polling Stations..... No. of Polling-Station Returns Received:.....

Name of Polling-Station	Votes received by candidate 1.____	Votes received by candidate 2.____	Votes received by candidate 3.____	Votes received by candidate 4.____	Votes received by candidate 5.____	Votes received by candidate 6.____	Votes rejected

Total valid votes received by each candidate at all polling-stations							Total rejected votes at all polling-stations _____
Total valid postal votes received by each candidate							Total rejected postal votes _____
Total valid ordinary and postal votes received by each candidate							Total rejected ordinary and postal votes _____
Total votes cast							
<p>I hereby certify that the above is a correct statement of all polling-station returns collated and postal votes counted at the abovementioned constituency centre</p> <p style="text-align: right;">(Signed).....</p> <p style="text-align: right;"><i>Constituency Elections Officer</i></p> <p>Dated this..... day of....., 20.....</p>							

Fig 4.23 V23 form (source statutory Instrument 21 of 2005)

Shown above is the Collation of Polling-Station Returns and Adding Together of Ordinary and Postal Votes.

ELECTORAL ACT [CHAPTER 2:13]

PARLIAMENTARY AND PRESIDENTIAL ELECTIONS: POSTAL BALLOT RESULTS			
Constituency Centre at:			
PART A: POSTAL BALLOT PAPER ACCOUNT			
Postal ballot papers received	No.	Postal ballot papers accounted for	No.
Nos. _____ to _____ inclusive		1. Ballot papers in ballot box..... 2. Ballot papers unused..... Nos. _____ to _____ inclusive	
TOTAL		TOTAL	
Postal ballot papers sent to applicants	No.	Postal ballot papers to applicants accounted for	No.
Nos. _____ to _____ inclusive		1. Placed in ballot-box..... 2. Rejected..... 3. Received after close of poll..... 4. Returned undelivered..... 5. Not accounted for.....	
TOTAL		TOTAL	
<p>I hereby certify that the above is a correct statement of all postal ballot papers received by me.</p> <p style="text-align: right;">(Signed).....</p> <p style="text-align: right;"><i>Constituency Elections Officer</i></p> <p>Dated this..... day of....., 20.....</p>			
PART B: RESULT OF COUNTING			
Names of candidates	Party /Independent	Valid postal votes received	
1.			
2.			
3.			
4.			
5.			
6.			

Valid postal votes received	
Postal votes rejected	
Total valid and rejected postal votes cast	

I hereby certify that the above is a correct statement of all postal votes counted at the abovementioned constituency centre

(Signed).....

Constituency Elections Officer

Dated this..... day of....., 20.....

Fig 4.24 V24 form (source statutory Instrument 21 of 2005)

4.7.3 Output design (Include all output forms/reports in the system)

The output design will also incorporate the forms prescribed in the statutory instrument 21 of 2005 as the official output capture layout of ZEC forms. All the forms will be used as they are, citing legal implications if the researcher decides to design completely new forms.

PROPOSED DESIGN FOR REPORTS RESULTS

NAME OF CANDIDATE	NAME OF PARTY	PHOTOGRAPH	SYMBOL	VOTE COUNT

Fig 4.25 Output design form

ELECTORAL ACT [CHAPTER 2:13]
(Section 67)

PARLIAMENTARY ELECTIONS: TELEGRAM TELEFASCIMILE OR ELECTRONIC MAIL
NOTIFYING THE RESULT OF POLL

To the Chief Elections Officer, Harare.

From the constituency elections officer for the constituency of

.....

date code word..... stop

Counting of votes completed stopreceived a total of

.....votes stopreceived a total of

.....votes stopreceived a total of

.....votes stop

Have declared to be duly elected stop

There were..... rejected papers stop

The percentage poll was..... End of message.

Fig 4.26 V15 form (source statutory Instrument 21 of 2005)

The telegram, telefacsimile or electronic mail notifying the result of an election of a constituency member in terms of section 67(1) of the Act.

ELECTORAL ACT [CHAPTER 2:13]

PRESIDENTIAL ELECTIONS: TELEGRAM, TELEFASCIMILE OR ELECTRONIC
MAIL NOTIFYING THE RESULT OF POLL

To the Chief Elections Officer, Harare.

Form the constituency elections officer for the constituency of

.....
.....

date code word..... stop

Counting of votes completed stop received a total of

..... votes stop received a total of

..... votes stop received a total of

..... votes stop

There were..... rejected papers stop

The percentage poll was End of message.

Fig 4.27 V16 form (source statutory Instrument 21 of 2005)

The telegram, telefacsimile or electronic mail notifying the result of an election of a Presidential candidate in terms of section 67(1).

ELECTORAL ACT [CHAPTER 2:13]

(Section 67)

PARLIAMENTARY ELECTIONS: RESULT OF POLL

To: The Chief Elections Officer, Harare

From: The constituency elections officer for the constituency of

In confirmation of my telegram/telefacsimile/electronic mail of notification of the result of the poll dispatched to you on, the details of the counting at the first count are as follows:

A.—

1. Name of candidate received votes
2. Name of candidate received votes
3. Name of candidate received votes
4. Name of candidate received votes
5. Name of candidate received votes
6. Name of candidate received votes

B.—

Details of the counting at the second count are as follows:

1. Name of candidate received votes
2. Name of candidate received votes
3. Name of candidate received votes
4. Name of candidate received votes
5. Name of candidate received votes

C.—

Details of the counting at the third count are as follows:

1. Name of candidate received votes
2. Name of candidate received votes
3. Name of candidate received votes
4. Name of candidate received votes

Where not appropriate, delete B and C above.

Accordingly, was declared duly elected.

There were spoiled ballot papers.

The percentage poll was*

Fig 4.28 V17 form (source statutory Instrument 21 of 2005)

The notice by the constituency elections officer confirming the telegram, telefacsimile or electronic mail of notification of the result of the poll which is referred to in section 67(2) of the Act shall be in form V.17 for Parliamentary elections.

ELECTORAL ACT [CHAPTER 2:13]

PRESIDENTIAL ELECTIONS: RESULT OF POLL

To: The Chief Elections Officer, Harare

From: The constituency elections officer for the constituency of

In confirmation of my telegram/telefacsimile/electronic mail of notification of the result of the poll dispatched to you on, the details of the counting are as follows:

FIRST COUNT

- 1. Name of candidate received votes
- 2. Name of candidate received votes
- 3. Name of candidate received votes
- 4. Name of candidate received votes
- 5. Name of candidate received votes

SECOND COUNT

- 1. Name of candidate received votes
- 2. Name of candidate received votes
- 3. Name of candidate received votes
- 4. Name of candidate received votes
- 5. Name of candidate received votes

There were..... spoilt ballot papers.

The percentage poll was*

Dated at

Constituency elections officer

* Divide the number of votes cast by the number of votes on the roll and multiply the result by 100.

Fig 4.29 V18 form (source statutory Instrument 21 of 2005)

The notice by the constituency elections officer confirming the telegram, telefacsimile or electronic mail of notification of the result of the poll which is referred to in section 67(2) of the Act shall be in form V.18 for Presidential elections.

	<table border="1"> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td>Name</td> <td>Login date & Logout date</td> <td>Login time & Logout time</td> </tr> </table>					Name	Login date & Logout date	Login time & Logout time
Name	Login date & Logout date	Login time & Logout time						

Fig 4.29 Log transaction report

4.8 Pseudo Code

McConnell (2004) describes pseudo code as a structured English syntax that is used to describe algorithms. Pseudo code allows a programmer to mainly focus on the program logic without having to worry about the code syntax. Implementation after describing logic using pseudo code becomes simpler. McConnell goes on to point out that in as much as hard coding the pseudo code is a good thing the eventuality is it will need to be changed.

4.8.1 User Authentication

Provide user_name and password

```

{
If correct then
{

    Go to System Main Form
}
Else
    Try again
{
    If login failed attempts =3 and login is unsuccessful then
        Go To Security Panel.
}
}

```

```

    End if
}

4.8.2 Register Candidate

Enter candidate details
{
    If saved = true
    {
    Then send login details email
    }
    If email sent = True
    {
    Then Save login credentials
    End if
    }
End if
}
    If email sent = False then
    {
        Resend email
    }
    Else Save candidate credentials

End if

End if

```

4.8.3 Results module

If station returns verified

Case 1 ward verification

Case 2 constituency verification

Case 3 national verification

```
    If result verified then
{
    Declare winner
    End If
}
Else
{
    Restart verification process
}
```

4.8.4 Change login credentials

```
Enter username
{
If correct then
{
Check old password and new password
Go to Authentication page
    End If
}
Else
{
    Try again
        If number of tries =3 and logon is unsuccessful then
            Log out
        }
}
End if
}
```

4.8.5 Report generation

```
Invoke a database query
{
```

```
If query is valid then
{
    Refresh report data
    View report on screen
    Set report to be printable
}
Else
    Generate error message to user
}
End if
```

4.9 Security design

Security design is the idea of engineering software so that it continues to function correctly under malicious attack. Most technologists acknowledge this undertaking's importance, but they need some help in understanding how to tackle it (McGraw, 2010). The researcher will make use of username and passwords that will prevent anyone from entering the system at any given time and period. There is also mac address logging of every machine that accesses the system along with a camera function to take snapshots of system users.

4.9.1 Physical security

According to the Field Manual of 2001 on physical security it defines physical security as the measures that an organization takes to make sure that no unauthorized access to system facilities, resources and hardware are granted through the use of physical barriers.

In terms of ZEC they already have a very secure biometric control system to access points and also cameras in the data Centre. In light of this the researcher can conclude that the system along with its supporting hardware will be safe from any intrusion although the same cannot be said about the equipment that will be sent out to polling stations.

4.9.2 Network security

DeCapite, (2006) defines network security as the process through which an organization takes preventive intrusion measures through the use of networking infrastructure.

For ZEC to effectively secure the system from network hackers or tapping of data they can make use of encryption during transmission. The system will automatically cipher data into an unreadable format during transmission so help protect it. Network security will also be achieved through the use of passwords when gaining access to the system

4.9.3 Operational security

According to the United States Defense department, Operations Security also known by its acronym OPSEC, is defined as the procedure through which an organization or individual protect their confidential information from intrusion. Many authors point out that in order to come up with an effective operation security policy one has to think like the enemy.

The researcher will make use of various operation security techniques in the relaying system to make sure election results are kept from public and intruders until a formal declaration of results is made. These will include for example validations to make sure in the event of a misconfiguration or wrong server credentials the system should not allow any relaying of results until proper authentication is established.

4.10 Conclusion

In this chapter the researcher looked to convert the logical system into actual physical designs. The chapter also demonstrated how the system will appear through the interface designs done. The following and final chapter will look to test the developed system in an actual operational environment.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

The current chapter looks to highlight the proposed system implementation basing on the previous design analysis. At this stage the following aspects of the proposed system will be considered in detail: coding of the system, various validations used to improve the system as well as the changeover strategies to be employed. On writing this chapter the researcher was still in the process of developing the system and hence the emphasis of the chapter won't be about actual implementation done rather what will be done upon completion.

5.2 Coding

Coding is a process of writing statements, scripts and instructions in order to instruct a computer device to do certain actions intended by the developer (Roth, 2011). The researcher is making use of the visual studio .net platform to write system code as well as the user interface. To best highlight the coding the researcher used below is a few code snippets of some of the functional and non-functional system requirements.

5.2.1 Speech Recognition code

```
Dim WithEvents recoMF As New Recognition.SpeechRecognitionEngine
Private Sub loadspeech()
    Try
        If Selection_Form.selct = True Then
            recoMF.SetInputToDefaultAudioDevice()
            Dim gram As New Recognition.SrgsGrammar.SrgsDocument
            Dim Rule As New
Recognition.SrgsGrammar.SrgsRule("command")
            Dim commandList As New
Recognition.SrgsGrammar.SrgsOneOf("P", "Home", "Exit", "Map")
            Rule.Add(commandList)
            gram.Rules.Add(Rule)
            gram.Root = Rule
            recoMF.LoadGrammar(New Recognition.Grammar(gram))
            recoMF.RecognizeAsync()

        End If
    Catch ex As Exception
    End Try
End Sub
```

5.2.2 Transaction Security Camera code

```
Public Sub loadphoto()  
    Dim arrImage() As Byte  
    sql_connection = New MySqlConnection("Data  
Source=localhost;user id=root;password=root;database=zec_er;")  
  
    Try  
  
        sql_connection.Open()  
        sql = "SELECT * FROM logtransactions WHERE user_name =  
'" + Label2.Text + "' and logindate = '" + Label4.Text + "' and  
logintime = '" + Label5.Text + "'"'  
        sql_command = New MySqlCommand(sql,  
sql_connection)  
        sql_reader = sql_command.ExecuteReader()  
        sql_reader.Read()  
        arrImage = sql_reader.Item("userimage")  
        Dim mstream As New System.IO.MemoryStream(arrImage)  
        PictureBox3.Image = Image.FromStream(mstream)  
        sql_reader.Close()  
        sql_connection.Close()  
    Catch ex As Exception  
        sql_connection.Close()  
        MsgBox(ex.Message)  
    Exit Sub  
    End Try  
End Sub
```

5.3 Testing

Testing according to Rani (2012) is the process through which software can be analyzed using various test cases and scenarios to ascertain the different ways in which it responds. For every new software that is developed it is essential to test it in different environments so as to make it user friendly and reliable as possible. The author performed various tests on the system that included white box testing, black box testing and also validation testing among a host of other procedures done.

5.3.1 Unit testing

Kossiakoff, (2011) cited that unit testing is when a software is broken down into units of code from which an attempt is made to evaluate the software's ability to undertake certain functions. This researcher undertook unit testing in two stages as described below.

5.3.1.1 Black box testing

A black box test is a test that is performed by the client or an outside influence that does not have knowledge of the development details of the system in question (Kossiakoff, 2011). The author selected at random various employees from ZEC from whom the test was carried out. Below is a depiction of the test that was undertaken.

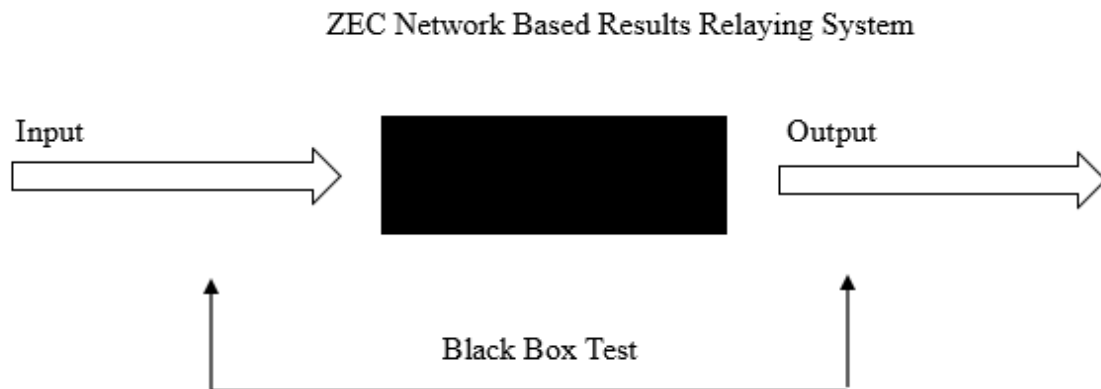


Fig 5.1 Illustrative representation of black box testing done at ZEC

5.3.1.2 White box testing

Kossiakoff goes on to characterize white box testing as an examination of the framework in view of the internal logic of the code. Because these tests are based on the code, it was the job of the researcher to perform this task. The visual studio platform comes with various tools from which the author used to perform white box testing like refactoring tools. The main aim of these tests is to ensure that the code is efficient and contains no bugs upon deployment. Below is a sample test that was done in the development of the system.

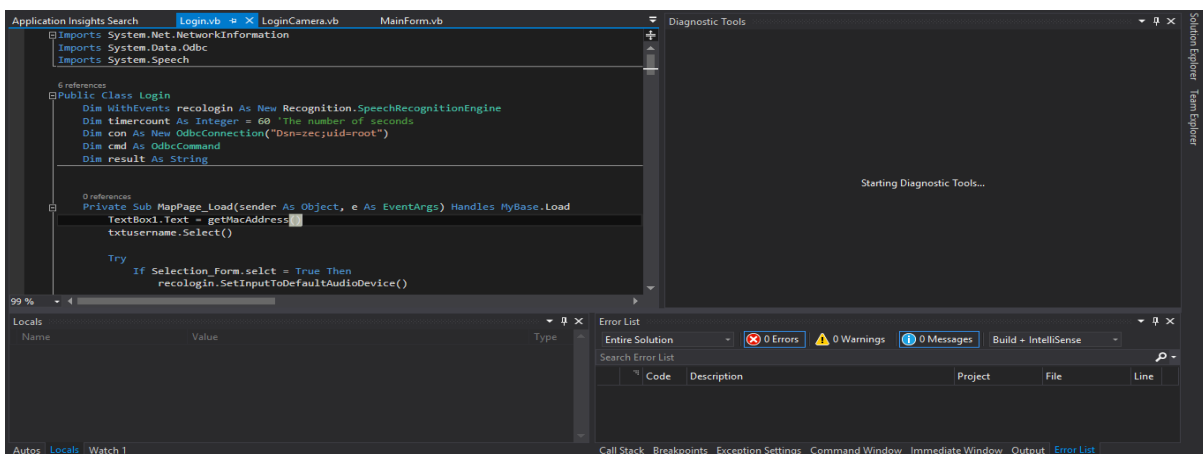


Fig 5.2 Sample system test

5.3.2 System testing

System testing verifies whether the framework or programming, works in the way that the software engineer plans it to work and the testing utilizes realistic client interface (Linz, 2014). The framework was tested utilizing ZEC personnel so that the right information would be used and proper assessment could be made on the performance of the system.

5.3.3 Module testing

This researcher did a lot of module testing as it is one of the most important tests to ensure software quality. Module testing was defined by Leffingwell, (2003) as a method for testing the framework through the utilization of individual modules of the framework. In order to ascertain whether the various system modules were functioning accordingly the analyst made use of the system reports. Through the reports the researcher was able to see any anomalies generated in the modules.

5.3.4 Acceptance testing

According to Powers, (2012). Acceptance testing is the point at which a framework is tested in order to see whether it is meeting clients or representatives prerequisites that they would have proposed during the requirements gathering stage. As a way to test acceptance this analyst conducted several demonstrations and observations of the system in use to verify whether the users were satisfied. The general consensus was that it meets all the requirements that had been communicated during the analysis phase.

5.3.5 System security testing

To demonstrate how security is enforced as per security design of 4.9 in chapter 4 the researcher will provide screen shot of the various security threats and how this has been effectively dealt with in the system.

5.3.5.1 Gaining access to the database

If any intruders manage to gain access to the database which is highly unlikely because of the firewalls and security authentication procedures in place, they will not be able to retrieve any

passwords from the system. The passwords are encrypted such that only the system can decrypt them.

User_Name	Password	User_Role	Email_Address	Surname	Forename
00-0000000 0 00	TqN1Cz76OPU=	ADMIN	waltrngwenya@live.com	ngwenya	walter
22-188287 c 22	zla9cZlc+zc=	PRESIDING OFFICER	rutemfiri@gmail.com	mfiri	ruth
63-1056978 x 43	07H0uomD7HA=	PRESIDING OFFICER	runganonhira@gmail.com	rungano	elizabeth
63-1408897 s 83	8l0ETObtlas=	PRESIDING OFFICER	rodrickshazhu@gmail.com	Shazhu	Rodrick
03-091226 c 03	h9aTC/T0GSvLjzRWT7Xdlw=	SUPPLEMENTARY	niskshumba@gmail.com	Shumba	Noel
43-048880 k 18	6MLUKJrQC+Q=	PRESIDING OFFICER	marvismasungo@gmail.com	masungo	marvis
63-165511 N 63	zeBRqN5avq2Rf9PW706ISQ=	PRESIDING OFFICER	jkampaundi@yahoo.com	Kampaundi	Joice
63-1324747 a 80	vqfSI94O4fE=	PRESIDING OFFICER	gmushaye@yahoo.com	Mushayi	Gerald
32-122644 r 32	KcEXo2djoTg3pXIs4cRL8A=	ADMIN	dnyamutamba@zec.gov.zw		
63-1127865 y 63	69affx74kEKPdvPnAEIbUw=	PRESIDING OFFICER	cganye@gmail.com	Ganye	Cephas

Fig 5.3 users database with encrypted passwords

5.3.5.2 Logging in to the system

When any user logs into the system it will take a snapshot of the user without the user knowing. This is a security mechanism employed by the user to help differentiate between system intruders and actual system users. Unlike most systems that don't leave such evidence as part of the system audit, the results relaying system will save these images in the database to be used for various reports.

loginDate	loginTime	logoutDate	logoutTime	user_Name	mac_address	userImage
01/04/2016	11:49:39 AM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
01/04/2016	12:23:54 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	1216D817325A	
01/04/2016	12:24:38 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
01/04/2016	12:28:20 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	1216D817325A	
01/04/2016	12:27:23 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	1216D817325A	
01/04/2016	12:31:01 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	1216D817325A	
02/04/2016	1:06:29 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
02/04/2016	1:11:46 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
02/04/2016	1:12:34 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
01/04/2016	1:13:57 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
02/04/2016	1:15:41 PM	LOGGED IN	LOGGED IN	00-0000000 0 00	3C970E53FB8B	
02/04/2016	2:12:32 PM	LOGGED IN	LOGGED IN			
02/04/2016	2:19:03 PM	LOGGED IN	LOGGED IN			
01/04/2016	2:23:03 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
02/04/2016	2:23:06 PM	LOGGED IN	LOGGED IN			
01/04/2016	2:23:24 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
01/04/2016	2:24:10 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
01/04/2016	2:25:28 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
01/04/2016	2:25:46 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	
01/04/2016	2:26:51 AM	LOGGED IN	LOGGED IN	29-2015331 s 67	3C970E53FB8B	

Fig 5.4 security camera audit

5.3.5.3 Trying to access restricted modules

When a user tries to access system modules that are not entitled to them the system will generate a message notification as shown below. The system will not let users access certain system modules unless authorized by the administrator through access levels.

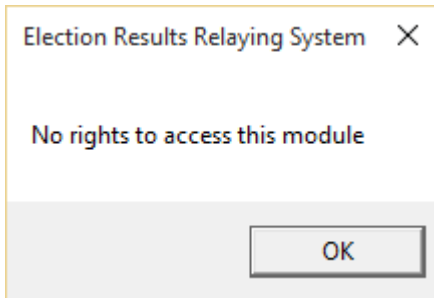


Fig 5.5 Error message for restricted access

5.3.6 System Validation

The author performed various system validation tests to make sure that no unwanted or wrong data would be fed into the system either by mistake or by gross negligence of the users. Since the results of an election are of art most importance, data capture and operation of election results through the system needed to be validated.

The following are some of the validation test that were carried out using different test scenarios

5.3.6.1 System Authentication Validation

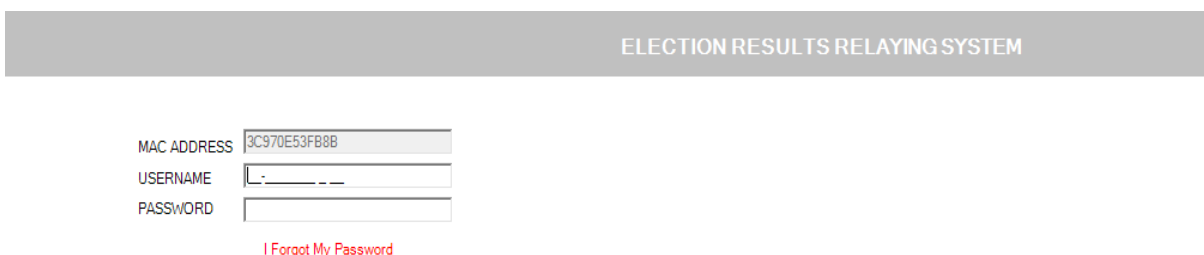


Fig 5.6 Login page

If the correct details are entered the system automatically logs in and save a transaction of the log, else it displays a message stating that login details failed to verify

5.3.6.2 Gridview Validation

Because most of the selections made within the system are of data that is already in the system database the data grid view was used to validate. Unlike letting users input certain details by themselves they have to select from only the information in the database.

9451 POLLING STATIONS NOT ASSIGNED

ctr	province	district	constituency	local_authourty	ward_number	polling_station	facility
1	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	EVELINE HIGH SCHOOL	School
2	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	MILTON JUNIOR SCHOOL	School
3	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	CITY HALL A	Community
4	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	CITY HALL B	Community
5	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	OLD BULAWAYO POLYTECHNIC COLLEGE	College Hal
6	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	MCKEURTAN PRIMARY SCHOOL	School
7	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	ROBERT TREGOLD PRIMARY SCHOOL	School
8	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	1	T.M HYPER	Tent
9	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	BAINES JUNIOR SCHOOL A	School
10	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	NEWMANSFORD PRIMARY SCHOOL	School
11	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	NORTHLEA HIGH SCHOOL	School
12	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	HUGH BEADLE PRIMARY SCHOOL A	School
13	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	TRENANCE PRIMARY SCHOOL	School
14	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	UMGUSA PRIMARY SCHOOL	School
15	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	AIRPORT PRIMARY SCHOOL	School
16	BULAWAYO PROVINCE	MZILIKAZI/KHUMALO	BULAWAYO CENTRAL	BULAWAYO CITY COUNCIL	2	UMVUTSHA FARM A	Community

Fig 5.7 Data grid view

5.3.6.1 Textbox and Texedit Validation

To ensure that information is filtered on the form. The researcher used textbox validation to limit certain characters in certain fields. For example as shown in the following Fig only numeric characters can be entered in the displayed text fields.

PART A: BALLOT PAPER ACCOUNT					
Ordinary ballot papers received		No.	Ordinary ballot papers accounted for		No.
Nos. <input type="text"/> to <input type="text"/>		<input type="text" value="0"/>	1. Ballot papers in ballot box.....	<input type="text" value="0"/>	
inclusive			2. Ballot papers unused.....	<input type="text" value="0"/>	
			Nos. <input type="text"/> to <input type="text"/>		
			inclusive		
			3. Ballot papers spoilt.....	<input type="text" value="0"/>	
			4. Ballot papers unaccounted for...	<input type="text" value="0"/>	
			TOTAL	<input type="text" value="0"/>	
			TOTAL	<input type="text" value="0"/>	

Fig 5.8 text edit illustration

5.3.6.1 Email Address Validation

The email addresses are essential to the system and hence had to be validated. For example when a user forgets a password only the system can recover the password using email, and also when relaying results to candidates the system will send emails notifications.to archive this validation the author used the following code.

```

Private Function emailaddresscheck(ByVal emailaddress As String) As Boolean
    Dim pattern As String = "^[a-zA-Z][\w\.-]*[a-zA-Z0-9]@[a-zA-Z0-9][\w\.-]*[a-zA-Z0-9]\.[a-zA-Z][a-zA-Z\.-]*[a-zA-Z]$"
    Dim emailAddressMatch As Match = Regex.Match(emailaddress, pattern)
    If emailAddressMatch.Success Then
        emailaddresscheck = True
    Else
        emailaddresscheck = False
    End If
End Function

```

This will display the following message

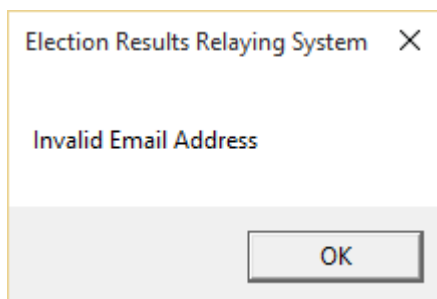


Fig 5.9 Email address error message

5.4 Installation

Installation involves either software or hardware and are the various steps and measures that should be carried out in order to successfully conFig and use a certain technology (Grady, 2010).

5.4.1 Data migration

To be able to use the ZEC results relaying system the following procedures will have to be done before installation even commences. The first stage is data migration of the software and database from the development machine on to the dedicated servers at the ZEC head office data Centre. This is not a process that is meant for users rather for the system administrators who are responsible for the system.

The following are the software requirements on the dedicated server

- MySQL server community version

This is the server used during development and also to be used on the deployment server. Unlike other MySQL technologies like Wamp or Xamp, the community installer is made specifically for servers and hence the researchers choice of this software.

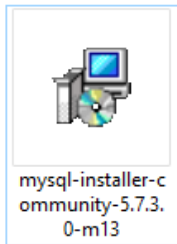


Fig 5.10 MySQL installer

- PremiumSoft Navicat Premium Enterprise

For easy navigation and manipulation of the database Navicat should be used although administrators can use other software's like MySQL Workbench that they are more comfortable with. Using this software, administrators are able to import and export the database between various environments and servers. The fig below show a screenshot of a database export procedure using Navicat software.

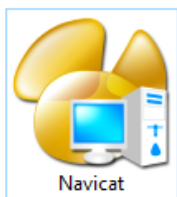
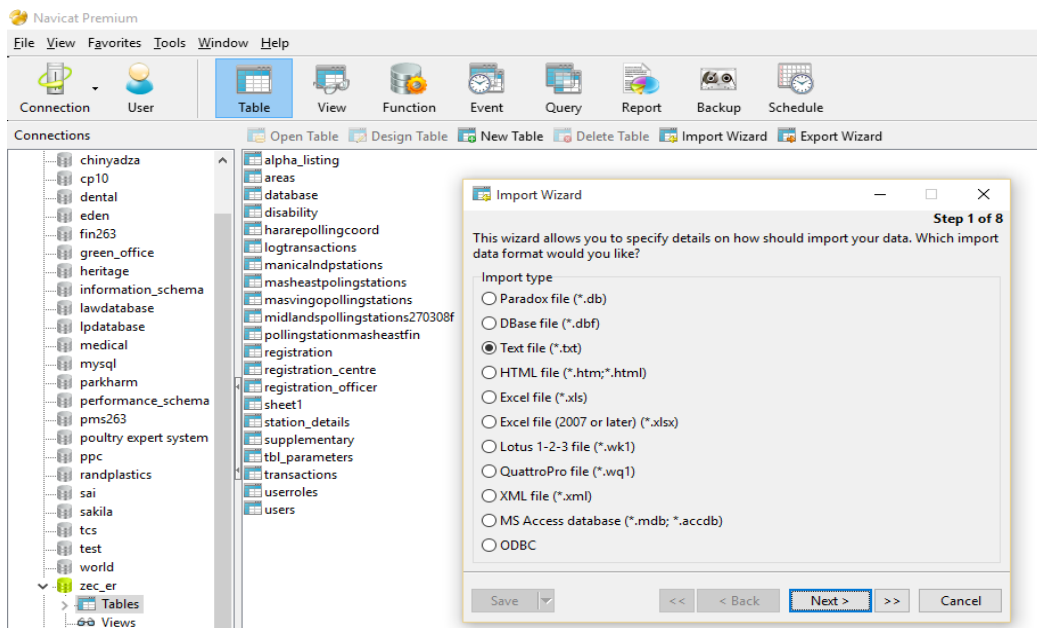


Fig 5.11 Navicat installer and sample page



5.4.2 User training

This is the procedure by which all the imminent clients of the framework are acquainted with the framework and are made to be completely familiar with all the modules within it (Whitten, 2010). The researcher recommends that ZEC organise regular training sessions with the staff that will undertake elections. A detailed user manual will also be made available in the system and this will be shown in the appendices section of this document.

5.4.3 System Conversion

Conversion is the process of changing from the old system to the new system, Chen (2011). It entails file transfer and initiation of new procedures. According to Chen Four main conversion strategies can be employed: the parallel strategy, the direct strategy, the pilot strategy and the phased approach strategy.

5.4.3.1 Parallel Strategy

Parallel changeover is when two or more systems are deployed to work at the same time either in the same location or in different locations. If ZEC is to employ this strategy it will greatly diminish the risk of failure and improve analysis of the old and proposed systems in an actual controlled environment. Upon satisfaction of the performance of a given software over the current one then the management can safely direct the termination of the old system.

5.4.4 Direct Change-Over Strategy

Direct change-over involves the total replacement of a system with another. Given the researchers experience with developing systems it comes as no surprise that such a risky strategy will be disastrous for the commission. Replacing a system totally is very costly and is risky in that, if the system fails there is not alternative strategy to relay the results to the command centres.

5.4.4.1 Pilot Study Strategy

The pilot operation changeover method involves implementing a completed new system at a selected location of the organization. Although this will help evaluate performance before an entire changeover it cannot be used for the election because one location cannot use a different system from the rest of the polling station to relay results.

5.4.4.2 Phased Approach Strategy

Chen (2011) describes Phased changeover as an approach that involves the gradual implementation of a software throughout an organisation. The author did not use this strategy as it tends to be costly depending on which areas are being used as the pilot projects. For example there are different wards with different sizes throughout the country so making an estimate of cost will only cater for one particular group.

5.4.4.3 Chosen Conversion Strategy

Subsequent to having analyzed the four conversion types, the parallel technique was chosen to be the most feasible method to use given the circumstances. The methodology's main advantage is it leaves the old framework as a fall back plan in case of failure. As ZEC staff eventually get to know the new framework, they can then fully move over to the new system.

5.5 Maintenance (Include recommendations on maintenance strategies)

Maintenance involves the continual job of keeping a system reliably performing to its full ability (Sward, 2006). There are various ways in which the system administrators at ZEC will be able to keep the system maintained and these include corrective measures, adaptive measures, perfective measures and preventive measures.

5.5.1 Corrective maintenance

According to Edwards, (2009), corrective maintenance incorporates changes and updates done so as to right or alter issues, which are either found by clients or brought up by client error reports.

5.5.2 Adaptive maintenance

Edwards defined adaptive maintenance as a process that incorporates adjustments and updates that ensure the software is stays up to date with the latest technological innovations. Given the resources and importance of the commission there will be pressure to continually update the system to meet international standards.

5.5.3 Perfective maintenance

Edwards goes on to define perfective maintenance as the upkeep of software that has been in operation for some time but because of regular use various tweaks and improvements can be

made to make it perfect. The researcher will employ this method within the system after a couple of months of usage. The changes that could be made to the election results relaying system are listed below.

- ZEC can over time improve the data input forms to allow quick data capturing.
- Designing a detailed and incisive help system
- Changes to the code to make it more responsive
- Re-organizing the database through normalization to improve access time and storage space

5.5.4 Preventative maintenance

In addition to adaptive and perfective maintenance, Edwards also defines preventive maintenance as upkeep that is frequently performed software to diminish the probability of it coming up short. Preventive upkeep is performed while the software is still working properly to prevent unexpected problems.

5.6 Recommendations for future/further development

The following is a list of recommendations that the researcher is making for future development of the system.

- Use of biometric voting to automatically feed vote into relaying system for real time updates to voting public
- Include facial recognition for logging in to the system
- Enable users to vote via mobile phones through the use of a fingerprint scanning app on the device before vote is cast
- Application should be multiplatform i.e. should run on all operating systems especially Linux which is less susceptible to viral attacks.
- Automatically register eligible voters from national registry and place a polling station based on residential details from school ,medical or phone records
- Improve fail safety by allowing system to plot relaying path via various path selection algorithms that use the least resources but least time.
- Employ three tier architecture development in all system modules to allow easy maintainability

5.7 Conclusion

The chapter looked to highlight the proposed system implementation basing on previous chapter findings. It looked at the different ways in which ZEC can implement the proposed election results relaying system. System tests were done to highlight to the management and the users that the system can withstand any form of security breach as well as handling the election results correctly. At this stage the process of maintenance will continue until the general public of the Zimbabwe are well satisfied with the electoral process. The system implementation was very successful and the researcher is very satisfied with the effort and knowledge gained undertaking the entire project.

REFERENCE LIST

1. Alexander Kossiakoff, William N. Sweet (2011). *Systems Engineering: Principles and Practices* p. 266
2. Baker, H. Kent, and Powell, Gary E., (2013) *Understanding Financial Management: A Practical Guide*. Blackwell Publishing.
3. Bass, Len, Paul Clements, and Rick Kazman. (2003) *Software Architecture in Practice*, 2nd ed. Addison-Wesley Professional.
4. Chapter 1: Physical Security Challenges". *Field Manual 3-19.30: Physical Security*. Headquarters, United States Department of Army. 2001.
5. Chen, M.T., (1996), "Simplified project economic evaluation." *Transactions of AACE International*. ABI/INFORM Global.
6. Cohan, P.S., (2005), "CFOs to Tech: 'I'll Spend for the Right Technology'." *Financial Executive* Apr 2005. ABI/INFORM Global.
7. Demirhan, D., Jacob, V.S., and Raghunathan, S., (2006), "Information Technology Investment Strategies Under Declining Technology Cost." *Journal of Management Information Systems*. Vol. 22 No. 3, Winter 2006. pp. 321 – 350
8. Fowler, Martin. *Patterns of Enterprise Application Architecture*. Addison-Wesley, 2002.
9. Harold Kerzner (2003). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling (8th ed.)*. Wiley. ISBN 0-471-22577-0.
10. Hoffer, J.A., George, J.F., and Valacich, J.S. (2010), *Modern Systems Analysis and Design*. 5th edition. Pearson Prentice Hall.
11. <http://wiki.osafoundation.org/Journal/HumaneUserInterface20041102> Laws of Interface Design accessed 15 February 2016
12. Kotonya, G. and Sommerville, (2003). *Requirements Engineering: Processes and Techniques* Chichester, UK: John Wiley and Sons.
13. Leffingwell, Dean and Don Widrig. (2003) *Managing Software Requirements: A Use Case Approach* (second edition). Addison-Wesley
14. Miles, M.B, and Huberman, A.M. (2008). *Qualitative Data Analysis*, 2nd Ed., p. 10-12. Newbury Park, CA: Sage.
15. Rossett, A., Sheldon, K. (2001). *Beyond the Podium: Delivering Training and Performance to a Digital World*. San Francisco: Jossey-Bass/Pfeiffer, p.67.

16. Self-Defending Networks: The Next Generation of Network Security, Duane DeCapite, Cisco Press, Sep. 8, 2006
17. Smith, A. (2005). Introduction to qualitative research, Pearson: USA
18. Sommerville, B. (2004). Software Development, London: Prentice Hall.
19. Sommerville, I. (2004). Software Engineering, 7th Edition, Addison Wesley: London.
20. Stellman, Andrew; Greene, Jennifer (2005). Applied Software Project Management (1st ed.). Cambridge, MA: O'Reilly Media
21. Stewart D W, Shamdasani P M. Focus groups. Theory and practice. London: Sage Publications, 1990.
22. Sward, David (2006). Measuring the Business Value of Information Technology. Intell Press. ISBN 0-9764832-7-0.
23. Warren, CAB., Karner, TX. (2005). Discovering qualitative methods: Field research, interviews and analysis. Los Angeles, CA, Roxbury Publishing Company.
24. Wartzman, Rick (2010) Bloomberg Business (Bloomberg Business.com). Retrieved 26 April 2016.
25. Whitten, Jeffrey L.; Bentley, Lonnie D.; Dittman, Kevin C. (2004). Fundamentals of systems analysis and design methods

APPENDICES

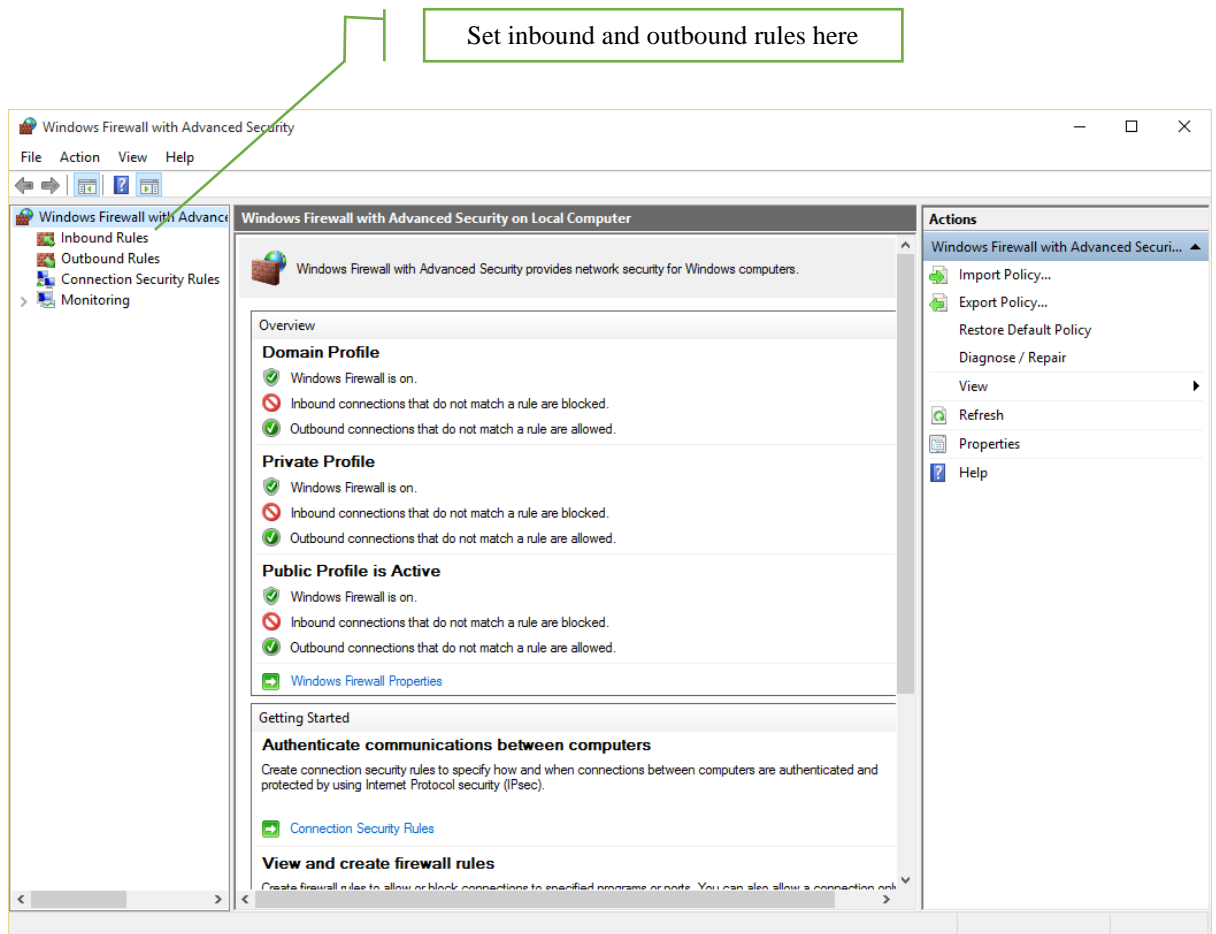
APPENDIX A : USER MANUAL

GETTING STARTED

Setting up environment

Firstly before the system is installed the following has to be done on the server

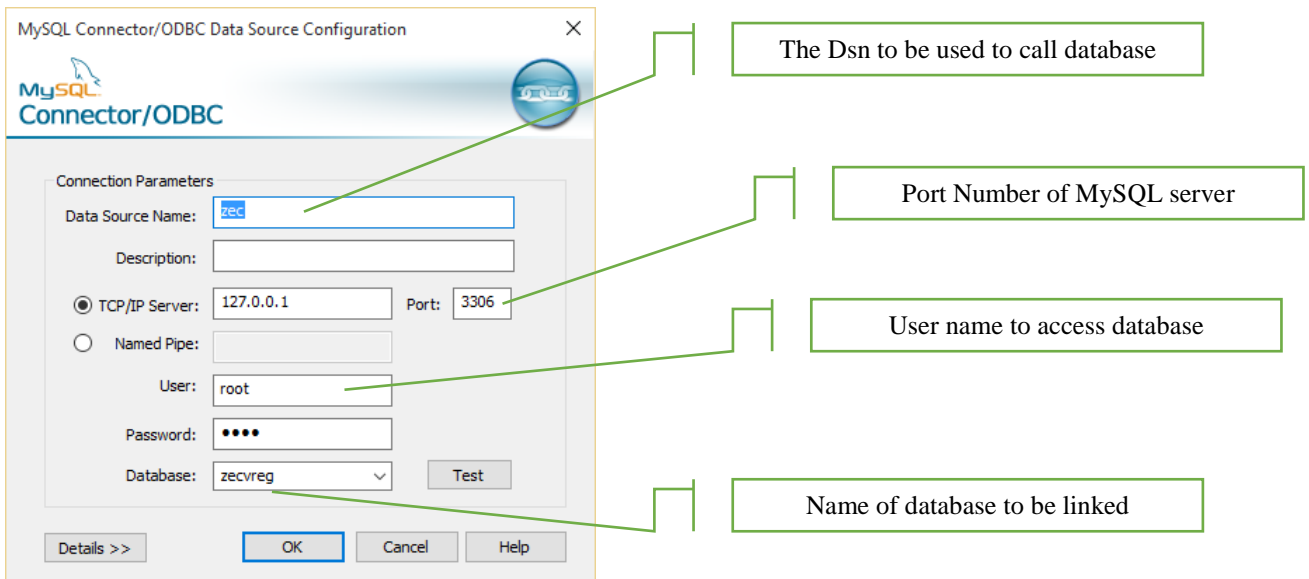
- i. **Allow incoming and outgoing communication to the database**



This is done via the control panel->system and security->windows firewall->advanced settings
From here all inbound and outbound rules are set to allow communication via the MySQL port 3306

- ii. **Configuring odbc driver on the client side**

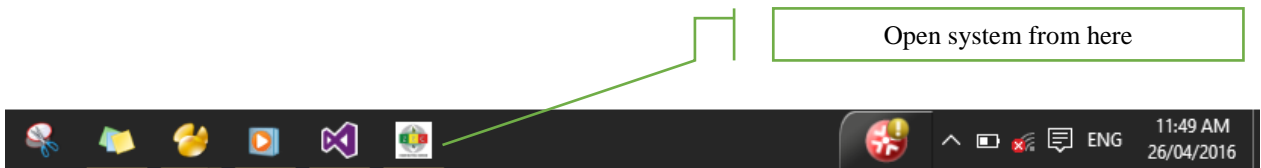
For access to be granted to all clients on the network the individual odbc's have to be configured to point to the server by specifying the server address and password



Getting to the Login Page

The system can be started from two different options:

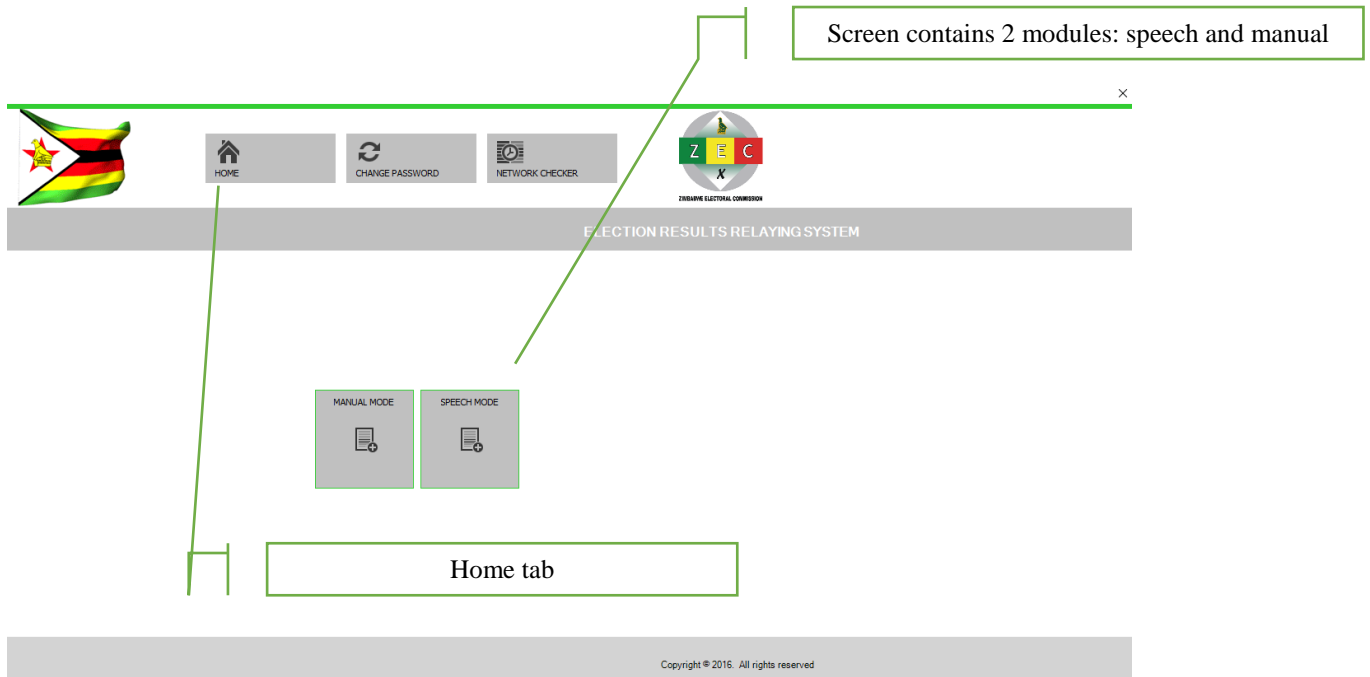
- either by clicking once on the ZEC icon pinned to your Task Bar:



- or by double clicking on the ZEC shortcut on your desktop

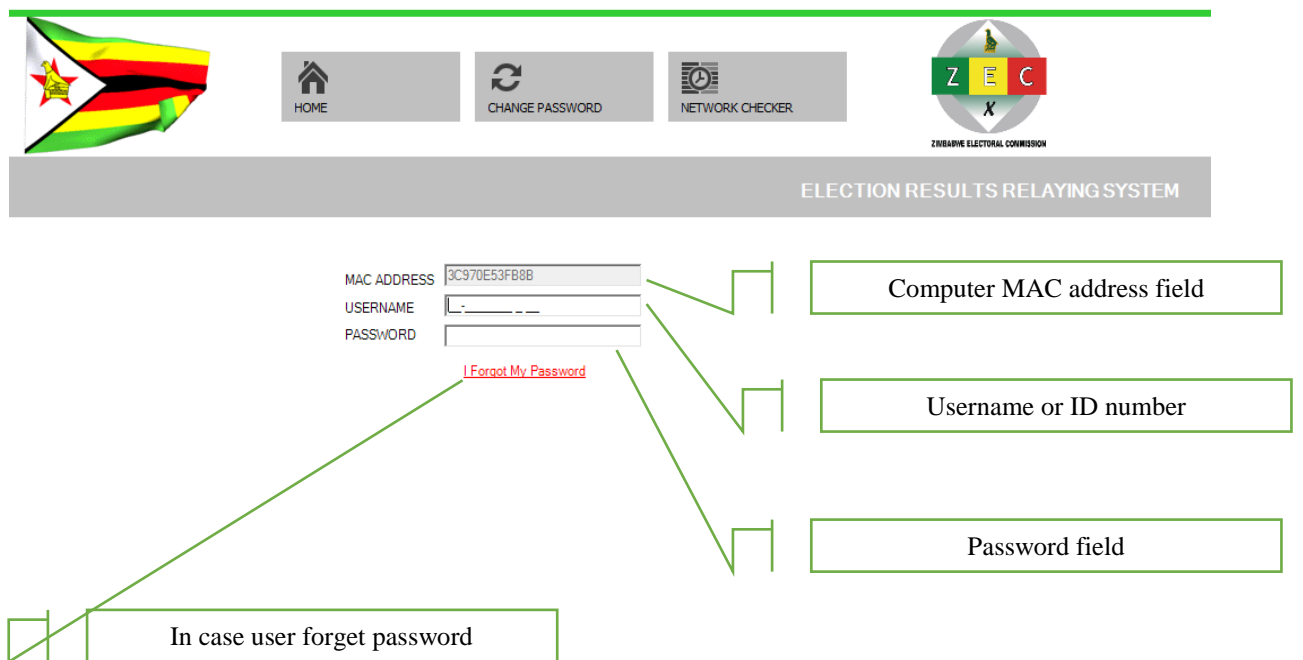


You should then be presented with the login screen:



From the selection screen a user can command the system through speech either to use manual mode or to use speech mode which is mainly to assist disabled staff.

The next form will be the login page which is the first authentication page of the system



The system will automatically pick up the mac address of the machine which along with the username and password will provide a better login log for the system. The user will only gain access into the system by entering a valid username and password in the log-in form. This will enable access to the relevant menu options, based on the user's access level. If a user

continuously enters the wrong password, the system will take a snapshot of the user and save in the database.

Accessing the system

Upon successful login the system will take a user to the home page

The screenshot shows the home page of the Zimbabwe Electoral Commission Election Results Relaying System. The page features a navigation panel on the left, a central content area with the commission's vision and mission, and a panel control on the right. Annotations with green boxes and lines point to various elements:

- Election maps**: Points to the 'MAPS' icon in the top navigation bar.
- To change password**: Points to the 'CHANGE PASSWORD' icon in the top navigation bar.
- Check if network is up**: Points to the 'NETWORK CHECKER' icon in the top navigation bar.
- Navigation panel**: Points to the left sidebar menu.
- Panel control**: Points to the dashboard grid on the right side of the page.

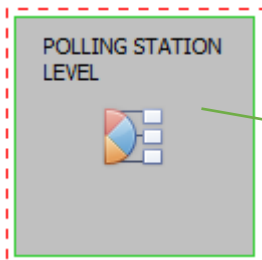
The top navigation bar includes the Zimbabwe flag, a close button (X), and the following icons: MAPS, CHANGE PASSWORD, NETWORK CHECKER, and the ZEC logo. The top right corner displays login information: TIME LOGGED IN: 5:09:05 AM, DATE LOGGED IN: 15/04/2016, USERNAME: [blank], and MAC ADDRESS: [blank]. The main content area is titled 'ELECTION RESULTS RELAYING SYSTEM' and contains a sidebar with links like 'ZIMBABWE ELECTORAL ACT', 'POLLING STATIONS', and 'WARD SUMMARY'. The central area shows the commission's vision and mission, along with a circular diagram of core values: Independence, Teamwork, Professionalism, Commitment, Integrity, and Transparency. The right panel control includes buttons for 'POLLING STATION LEVEL', 'WARD LEVEL', 'PROVINCIAL LEVEL', 'COMMAND CENTER', 'ADMINISTRATION', and 'NOMINATION', along with a calendar for March 2016.

From the resultant home page the user can now have access to a variety of system functions

Polling station level

The polling station level module includes the following sub modules

- **V11 form**
- **V11 verification**
- **Polling station statistics**
- **Print V11 return**



Click to access polling module

Clicking the following panel will bring out the polling station form from which the above listed functions can be performed

The resultant page is shown below

A dashboard with four grey panels arranged in a 2x2 grid, enclosed in a dashed red border. Each panel has a document icon with a plus sign. Callout boxes with green borders and lines pointing to the panels provide instructions: "To access v11 form capture" points to the top-left panel; "To verify v11 form" points to the top-right panel; "To print v11 form return" points to the bottom-right panel; and "To get polling station stats report" points to the bottom-left panel.

V 11 FORM	V 11 VERIFICATION
POLLING STATION STATISTICS	PRINT POLLING STATION RETURN

V11 form

The V11 form is the first election data form that the eventual election result emanates from .the form is filled in by the presiding officer and verified by observers and political party representatives.

Page 1 of V11 form

Polling station name

Enter ballot figures

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The form will make queries to the voter registration database to ensure that the result of poll does not exceed the registered number of voters in that polling station

After verification process the presiding officer will be able to print copies of the station results that will be displayed outside via the following panel

Panel to print poll result

The following form will be show

Specify number of copies

Specify printer

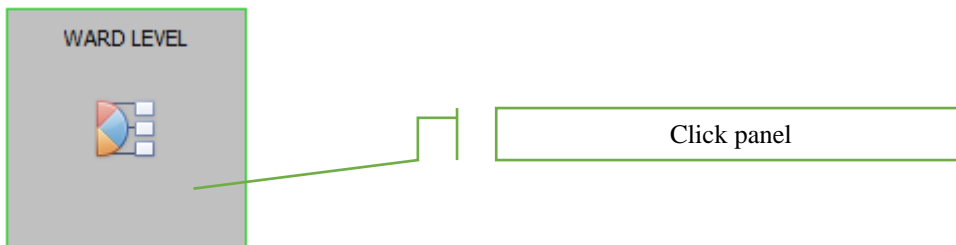
Printer Properties

Ward level

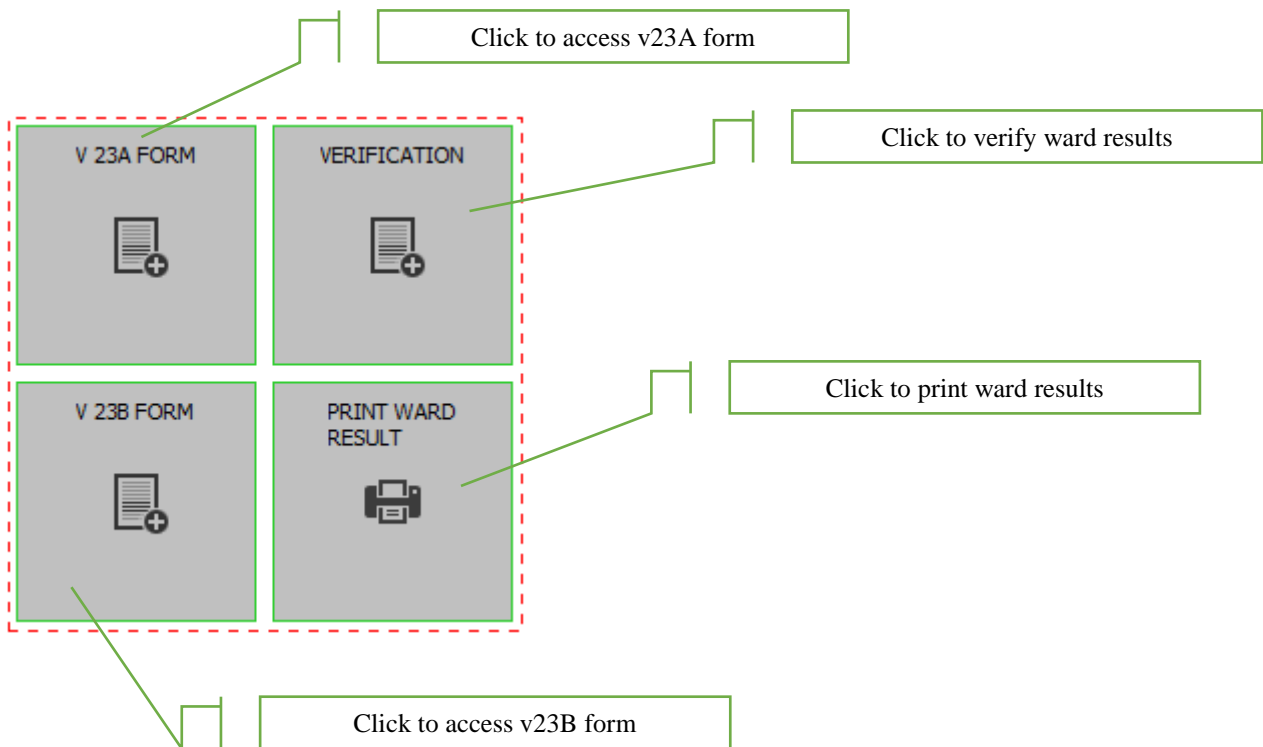
The Ward level module includes the following sub modules

- **V23A form**
- **V23B form**
- **V23 verification**
- **Ward statistics**
- **Print V23A return**
- **Print V23B return**

The ward module can be accessed from the following panel



Clicking the panel will bring out the following page



V23 form

The V23A form is the second election data form that the eventual election result emanates from. The form is filled in at the ward level and verified against the V11 forms. It is for the Collation of Polling-Station Returns and Adding Together of Ordinary and Postal Votes

V23 pages click to navigate

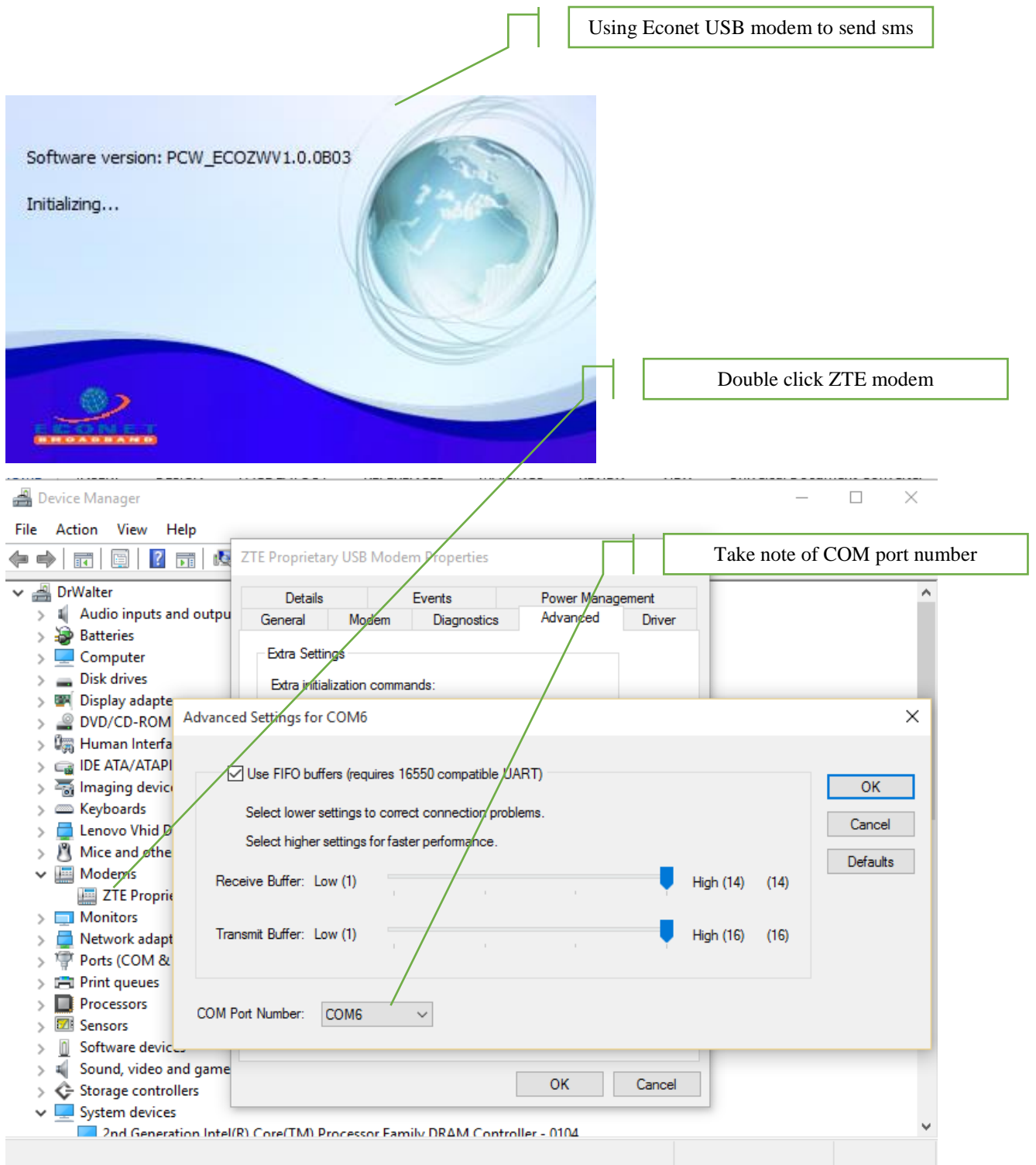
Vote count

Polling station name

The system contains such similar form although with different names and structure up to the national command where results is announced

For sending sms's through the system the following configurations are to be made

- I. Accessing the computer device manager



The port number will be used for incoming and outgoing messages from the system. The sms platform is meant to improve the system dependency in case of network failure.

For a more in depth user manual please refer to the system help file

APPENDIX B: FOCUS GROUP

ZEC FOCUS GROUP DISCUSSION

FOCUS GROUP: DEMOGRAPHIC DETAILS QUESTIONNAIRE

Please answer the following questions in the spaces provided, circle or tick the most appropriate options.

1. Are you: (please tick as necessary) Male Female

2. What is your professional background?

Elections Officer

Polling Officer

Management

Voter Educator

Field Officer

Other: (please describe) _____

3. How many years of experience have you had in this current job?

<1 Year 1-2 Years

2-5 Years 5-10 Years

>10 Years

4. Experience in Election Management (optional):

<1 Year 1-2 Years

2-5 Years 5-10 Years

>10 Years

FOCUS GROUP: DISCUSSION GUIDE

Facilitator's welcome, introduction and instructions to participants

Introduction: This focus group discussion is designed to assess your current thoughts and feelings about the introduction of an electronic network based election results relaying system in your electoral system. The focus group discussion will take no more than two hours.

Ground rules

- The most important rule is that only one person speaks at a time. There may be a temptation to jump in when someone is talking but please wait until they have finished.
- There are no right or wrong answers
- You do not have to speak in any particular order
- When you do have something to say, please do so. There are many of you in the group and it is important that I obtain the views of each of you
- You do not have to agree with the views of other people in the group

FOCUS GROUP NOTE-TAKING SUMMARY

Date of Focus Group	April , 2016
Location of Focus Group	Gweru
Number of Participants	4
Moderator Name	Walter Ngwenya

Responses to Questions

Question 1

Brief Summary/Key Points

APPENDIX C: INTERVIEW GUIDE

ZEC INTERVIEW QUESTIONS	
Date of Interview	April , 2016
Location of Interview	Gweru
Moderator Interviewer	Walter Ngwenya

1. As a candidate or the general public were would one go to find past election results, including information about votes cast for candidates and on the number of polling stations and wards? Would including this information in new system be a welcome enhancement?
2. Given your experience with the current results relaying system would you consider it effective enough to disregard the introduction of a new a new system?
3. Can you outline the challenges if any, which you have noted within the current setup that can be addressed or improved by the proposed network based results aggregation and collation?
4. In terms of using the current system, what are your views in relation to usability for disabled employees? Does the current system cater effectively for our disabled members of society?
5. As a candidate how would I be able to access information that relates to my candidacy? I.e. notification of election result or the various election results source forms for verification purposes.
6. Are there any ways the current system ensures that results tally with the number of voters registered within a particular polling station, ward and constituency?
7. What recommendations would you make to improve efficiency within the current system?

APPENDIX D: CODE SNIPPETS

Camera Code

```
Private Sub takepic()
    sql_connection = New MySqlConnection("Data
Source=localhost;user id=root;password=root;database=zec_er;")
    'sql_connection = New MySqlConnection("Data
Source=localhost;user id=root;database=zec_er;")
    Try
        sql_connection.Close()
        sql_connection.Open()

        Dim mypic As Image = CameraControl1.TakeSnapshot
        PictureBox4.Image = mypic

        Dim FileSize As UInt32

        Dim mstream As New System.IO.MemoryStream()
        PictureBox4.Image.Save(mstream,
System.Drawing.Imaging.ImageFormat.Jpeg)
        Dim arrImage() As Byte = mstream.GetBuffer()
        FileSize = mstream.Length
        mstream.Close()
        'MsgBox(FileSize)

        Timer2.Stop()
        sql_command = New MySqlCommand("Update
logtransactions set userimage=(@image_data) where user_name=(' +
lblUsername.Text + "') And logintime = (' + timeIn.Text + ')",
sql_connection)
        sql_command.Parameters.AddWithValue("@image_data", arrImage)
        sql_command.ExecuteNonQuery()
        'MsgBox("Image has been saved.")
        sql_connection.Close()

        CameraControl1.Stop()
    Catch ex As Exception
        sql_connection.Close()
        Timer2.Stop()
        CameraControl1.Stop()
        MsgBox(ex.Message)
    End Try
End Sub
```

Speech Recognition Code

```
Private Sub loadspeech()
    Try
        If Selection_Form.selct = True Then
            recoMF.SetInputToDefaultAudioDevice()

            Dim gram As New Recognition.SrgsGrammar.SrgsDocument
```

```

        Dim Rule As New
Recognition.SrgsGrammar.SrgsRule("command")

        Dim commandList As New
Recognition.SrgsGrammar.SrgsOneOf("P", "Home", "Exit", "Map")

        Rule.Add(commandList)

        gram.Rules.Add(Rule)

        gram.Root = Rule

        recoMF.LoadGrammar(New Recognition.Grammar(gram))

        recoMF.RecognizeAsync()

    End If
Catch ex As Exception

End Try
End Sub

```

Password Recovery Code

```

Public Class Recovery
    Dim objGsm As AxSms.Gsm = New AxSms.Gsm
    Dim objSmsConstants As AxSms.Constants = New AxSms.Constants
    Dim con As New OdbcConnection("Dsn=zec;uid=root")
    Dim cmd As OdbcCommand
    Dim passwordR As String
    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles
Button1.Click
        Try
            ' Set the wait cursor. Sending an SMS message can take a
            couple of seconds depending
            ' on the provider and the GSM device used.
            Cursor.Current = Cursors.WaitCursor

            ' Open the GSM device. This can take a couple of seconds. When
            the device is opened
            ' the AxSms.Gsm component will enter the PIN and do some basic
            initialization. By
            ' default the component will wait until the GSM device is
            registered on a GSM network.
            objGsm.Open(cbxDevices.Text())

            ' Create a new SMS message and configure it for sending.
            Dim objSms As New AxSms.Message()
            objSms.ToAddress = txtToAddress.Text
            objSms.DataCoding = 1
            objSms.Body = txtBody.Text + passwordR
        
```

```

        Dim strReference As [String] = objGsm.SendSms(objSms,
objSmsConstants.MULTIPART_ACCEPT, 0)

        ' It's recommended to close and re-open the GSM object between
        sending or receiving
        ' batches of messages. This forces the Gsm component to re-
        initialize the device.
        ' re-initialization may be necessary if the device could have
        been disconnected or
        ' powercycled (e.g. maybe the device was hot-swapped or the
        SIM was swapped).
        objGsm.Close()
        MsgBox("Password recovered check Phone")
        Dispose()
    Catch ex As Exception
        MsgBox(ex.Message)
    End Try

End Sub

Private Sub txtToAddress_TextChanged(sender As Object, e As EventArgs)
Handles txtToAddress.TextChanged
    Try
        con.Open()
        cmd = New OdbcCommand("Select password from users where
Phone_Number='" + txtToAddress.Text + "'", con)
        Dim result As String = cmd.ExecuteScalar
        con.Close()
        Dim MyCrypt As New crypt
        Dim password As String
        password = MyCrypt.Decrypt(result)
        passwordR = password
    Catch ex As Exception
        con.Close()
        MessageBox.Show(ex.Message, "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error)

    End Try
End Sub
End Class

```

APPENDIX E: APPROVAL LETTER



ZIMBABWE ELECTORAL COMMISSION

Zimbabwe Electoral Commission
1 Nelson Mandela Avenue
Corner Kaguvi & Jason Moyo Avenue
Private Bag 77
Causeway
Harare
Telephone: 263-04-759130, 7740
752950, 756252, 7740
752749, 752937, 7550
Fascimile: 263-04-770660/7819

Ref: A/1/

7 December 2015

Mr Walter Ngwenya
Midlands State University
Gweru

APPLICATION TO CONDUCT ACADEMIC RESEARCH IN THE ZIMBABWE ELECTORAL COMMISSION

Reference is to your application dated 10 November 2015 regarding the above stated subject matter.

Your application to carry out academic research in the Zimbabwe Electoral Commission has been granted on condition that information that you gather during the research will be treated with utmost confidence and that you provide the Zimbabwe Electoral Commission – Chief Elections Officer with a copy of the final document upon completion of your research.

Could you please sign the slip below as a way of acknowledging the conditions.

Mrs C. Chiswo
Acting Director – Human Resources
Zimbabwe Electoral Commission

I, Walter Ngwenya I.D: 29-2015331567 agree to provide the Zimbabwe Electoral Commission with a copy of the research paper.

Signature Date 18-01-2016