ELECTRONIC ENERGY METER MANAGEMENT SYSTEM (EEMMS)

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ENERGY METER MANAGEMENT SYSTEM

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ABSTRACT

The core aspect behind developing Electronic Energy Meter Management System (EEMMS) was a result of inefficiency of the manual system that was used at the organization. The main aim was to develop a computerized system that will curb the problems currently encountered by using the existing manual system by integrating information systems process. The instruments which were used to come up with the system include MySQL database, Adobe Dreamweaver CS6, SMTP email service and Apache server. Various feasibility studies were carried out to identify if it is worthy to build the new system. Feasibility studies has shown that the available hardware and software can be used with the new system without facing any challenges and that the benefits of the new system outweigh its costs. Information gathering methodologies were used to identify how the old system works. These include interviews, questionnaires and observations. The system was designed by making much emphasis on the architectural, physical, database and logical design. The system was tested using various testing techniques which encompasses black box and white box testing. Validation and verification processes were carried out and proved that the system meets that expected standards. The system was installed using the parallel run conversion method. The system needs to be maintained for it to provide best results. The users of the system are recommended to stick to the basics learnt during the training, and should they face any problems, they should consult the system administrator.

DECLARATION

I MAKONZA EVIDENCE (R167821P), do hereby declare that I am the sole author of this dissertation. I authorize Midlands State University to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature……. **Date ……..**

APPROVAL

This dissertation "**Electronic Energy Meter Management System (EEMMS)**" by **Makonza Evidence** meets the regulation governing the award of the degree of **Bachelor of Science in Information Systems Honors Degree** by Midlands State University and is approved for its contribution to knowledge and literary presentation.

Supervisor……

Date…….

ACKNOWLEDGEMENTS

I foremost give praise to the Lord Jesus, for it is by his grace for me to reach this far. Special thanks dedicated to my supervisor Ms. B. Mugoniwa who initiated the direction and support through the course period of my project research. I also acknowledge that through her support I will be somebody better in my research studies. More love to my family who cares much about my life and believes that in any way I will make it through the work of Christ in me the hope of Glory.

DEDICATION

Mostly I dedicate all the best to my wife who is so loving and caring.

Contents

LIST OF ACRONYMS

CEO……. Chief executive officer

ORGANOGRAM ……Organizational structure

NPV……. Net Present Value

ROI ……..Return on investment

SQL …….Structured query language

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

This chapter mainly focuses on the problems that are encountered by current system that is used by ZETDC in managing energy meters. This chapter explains the background study of the organization so as to reveal the motive behind of developing the proposed system. The problems encountered by the current system are outlined as well with the objectives of the current system are stated. The instruments that are going to be used in the development of the proposed system are going to be discussed in this chapter. The justification of the study is clearly explained in this chapter and finally the conclusion.

1.2 BACKGROUND OF THE STUDY

This project and study aims to assist the (ZETDC) Zimbabwe Electricity Transmission and Distribution Company in the management of its prepaid electricity meters and resolve the challenges that the company is facing due to the tempering if its meters through vandalism by customers and by tempering with the gadgets provided and installed at their homes. Vandalism deprives ZETDC of huge sums of revenue that is caused by the bridging or bypass of the charge meters, the presence of a bridge at the meter allows power to flow and be used for free use by the customer without being billed and this results in the organization losing revenue. When there is faulty meter at an organization or private residence, the client is affected positively and negatively in the sense that the meter may start to overcharge the customer by charging at an exorbitant rate and on the other hand the customer is prevented from using free electricity.

1.2.1 BACKGROUND OF THE ORGANIZATION

The Zimbabwe Electricity Distribution Company's (ZEDC) core business is to distribute and sell electricity to customers or users. ZETDC plans its distribution of electricity from domestic to commercial and industrial ensuring correct phase and voltage is availed. ZESA holdings the mother of ZETDC has many subsidiaries which are: The Zimbabwe Power Company (ZPC) responsible for the power stations that can take various forms, and was incorporated in 1996, PowerTel is another branch in Zesa that deals with internet services provision and broadband services, it owns a huge length of optical fiber across the country.

Zesa Enterprises (ZENT), another subsidiary with a different portfolio has the drive into new engagements such as land development and irrigation works among others. The electricity that is used and distributed by the ZETDC is locally generated at Hwange Power station, Kariba Hydro Electricity, Munyati Power Station and Bulawayo, however some of it imported from countries that are neighbors and non-neighbors to Zimbabwe such as Mozambique, South Africa, and DRC. ZETDC is currently the sole distributer of electricity and thus it has so much monopoly in the industry of electricity for both private and public sectors of the economy which include domestic and commercial. Zesa prepaid meters are mostly applicable to domestic and small entities while large organizations prefer the old billing system where the ZETDC sends them a monthly bill of electricity used by them. Private organizations and individuals especially domestic shy away from postpaid arrangements as they feel shortchanged by the power company.

1.2.2 ORGANIZATIONAL STRUCTURE

Organizational structure, how an organization puts its people or employees and jobs in order for its work to be performed and its tasks and goals can be achieved (Aquinas 2008). Work has to be divided and clear chain of command spelt out for both decision making and conflict resolution. Decisions can be tactical, managerial or strategic depending on the level which they are made. An organogram is important as it clearly reveals these chain of command. ZETDC is composed of sections which it terms as regions and below is the structure and branched that can be found in particular different regions. The regions available are the Southern Region, Northern Region, Southern Region, Harare Region and Eastern Region, all these are scattered around Zimbabwe with their General Managers and the Head office in Harare the capital.

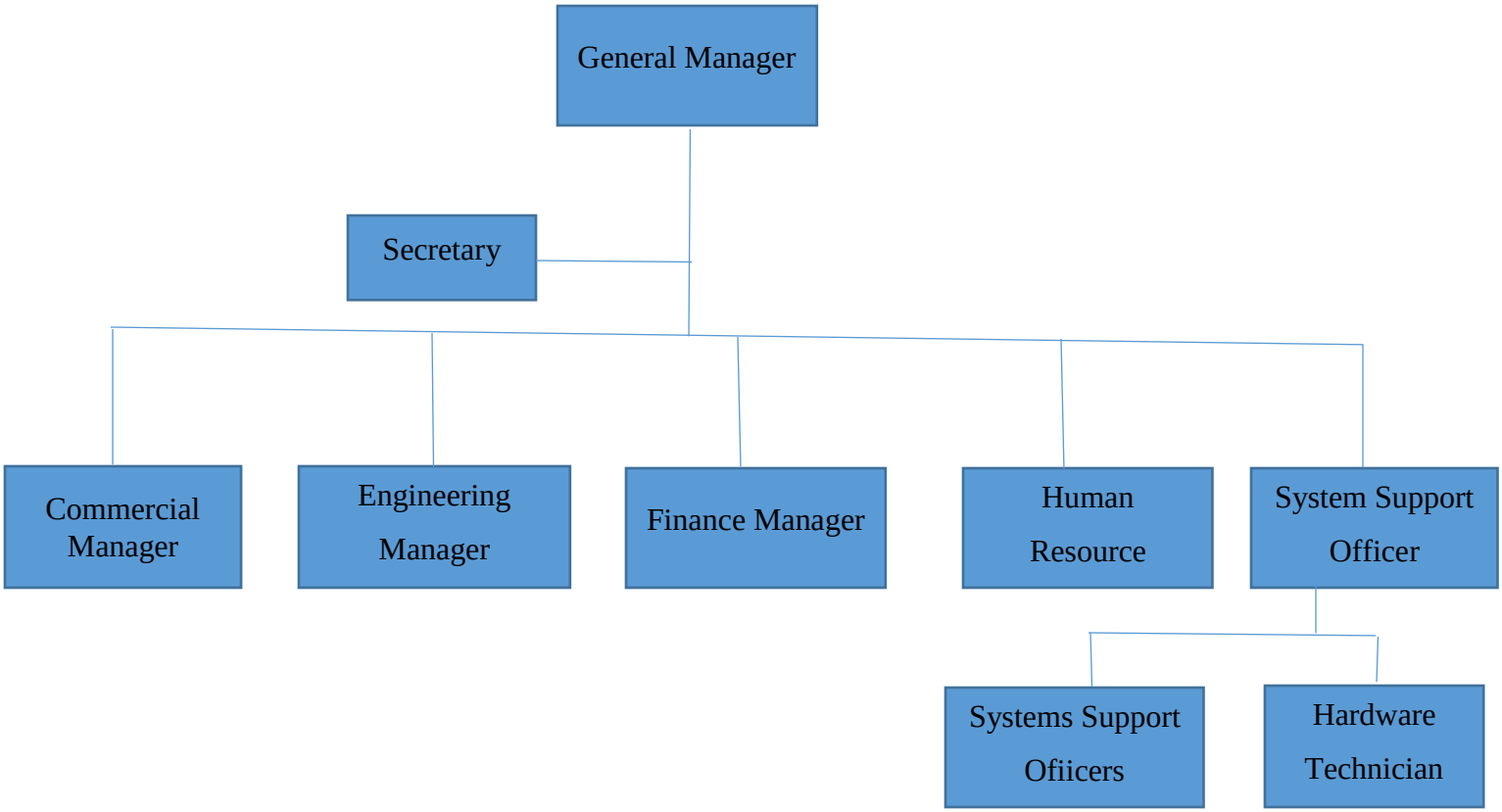

Fig 1.1 Organizational Structure of ZETDC

1.2.3 ZETDC VISION

To foster convenience to customers by providing adequate, safe, reliable electricity competitive prices.

1.2.4 MISSION STATEMENT

Committed to the provide quality electricity engineering for consumers throughout Zimbabwe and the region, and create value for the stakeholders.

1.3 PROBLEM DEFINITION

ZETDC has vast investments in terms of properties and their prepaid billing meters and postpaid meters are not to be spared. The meters provide the source or charge and thereby directly influencing revenue of the organization. Damage or suspected tempering with these devices will cost the organization some money in terms of revenue and operational costs. At the moment, the county is facing a lot of foreign currency shortages and most equipment used by ZETDC is imported from the prepaid meters, postpaid meters, electrical transformers and transformer oil to

mention but a few, thus vandalism or tempering for the sake of bypassing the billing system or any other motive cannot be tolerated and thus we invented this system which I will call the Electronic Energy Meter management system (EEM). Currently ZETDC has no mechanism to monitor the state of these gadgets unless there is a fault raised by customers through their call Centre, and mostly customers do not send requests when the fault is for their benefit.

1.4 AIM

The research study aims to develop an Electronic Energy Meter Management System that will curb the problems currently encountered by using the existing manual system.

1.5 OBJECTIVES

- Manage client standard family consumption of energy on monthly basis and generate a report to be worked on by users of the system (ZETDC).
- To meet customer demand and perform data mining on historical information activities.
- To come up with a security support system that locates non- performing metering points through the analysis of patterns with reference to standardized or trending consumption.
- To facilitate monthly monitoring of power consumption by customers for assessment and usage tracking.
- To enable ZETDC management make quick decision from the presented information.
- To curb unfair charging on the part of both the consumer and service provider.
- Acquire data on the life expectancy (lifespan) of the prepaid meters through fault tracking.

1.6 INSTRUMENTS AND METHODOLOGIES

Kumar (2014) posits that instruments are used to carry out certain tasks and methods are techniques used to collect information from stakeholders necessary to understand the activities of on a system and their expectations from that activities.

1.6.1 METHODOLOGIES

The following methodologies were used to collect information on how the current system works.

- Observation

- Questionnaires
- Interview

1.6.2 SOFTWARE DEVELOPMENT TOOLS

Macromedia Dreamweaver 8

A system used for system development and is the world number one platform and thus the developer decided to adopt it I this particular endeavor.

Cascading Style Sheets 3 (CSS3)

CSS to be used for interface design of our system, it can be used on pages for the purpose of formatting (design/styling) information and create a good user interface. It is coupled with many attributes that promote the beauty of display and clear projection of windows.

MySQL

MySQL for database and supports the system in question, freely available open source Relational Database Management System (RDBMS) which uses Structured Query Language (SQL). SQL well known language for adding, accessing and managing content in a database. It is most noted for its quick processing, proven reliability, ease and flexibility of use.

Hypertext Pre Processor (PHP)

PHP is a programming language for use in this help desk system design. PHP is an acronym for PHP: Hypertext Preprocessor, which is a scripting language used to create dynamic and interactive HTML Web pages. A server can process most PHP commands when a website visitor opens a particular page, then sends results to the visitor's browser.

1.7 JUSTIFICATION OF THE STUDY

The System (EMM) Electronic Energy Meter Management System is meant to give efficiency and reduce outage time. It is expected to reduce cases of vandalism of energy meters through electronic monitoring. All non performing points will be identified through managing installed energy meter consumer homes. The system will also support fault detection of meters and calls for appropriate action depending on the cause of the fault. Through managing energy meters,

ZETDC will maximize revenue collection because all those who temper around with the energy meters will be identified and given stiff penalties. The system will also recommend allocating meters to customers in need of replacement or new installation.

1.8 CONCLUSION

In this chapter, we briefly looked at the challenges being faced by the current operational system and looked at the advantages that can be derived from complementing the existing system with a decision support system that will be developed by modern technology. Careful planning and strategy of resources is needed. The feasibility aspect is of importance as well and thus will be looked at in the next chapter.

CHAPTER 2: PLANNING PHASE

2.1 INTRODUCTION

This chapter shows how the proposed system will offer business value to the organization. The researcher used feasibility study to determine how feasible the proposed system was. The feasibility study included technical feasibility, economic feasibility, social feasibility and operational feasibility. The chapter also gives an outline of the activities that constitute the development of the proposed system as well as the time required on each activity. Risk analysis was also carried out which included analyzing technical, economic, performance and implementation risks. Stakeholder analysis was carried out to determine the interest of various stakeholders on the development of the proposed system. Finally the chapter ends with a conclusion.

2.2 BUSINESS VALUE

Tangible and intangible benefits that the proposed system is expected to deliver are referred to as business value of the system (Baker, 2014). The researcher explained how the proposed Electronic Energy Meter Management System is going to be of benefit to both the employees and the customers. The proposed system is expected to monthly manage domestic electricity consumption by highlighting points of connection where there is either extreme consumption rate or very low consumption rate. The system takes into consideration the standard consumption rate and gives allowance for either consuming slightly higher than the expected or slightly lower.

The proposed system will manage consumption of electricity by making an analysis of customer historical data through a process known as data mining. This would help to identify faulty or non- performing energy meters through the process of pattern analysis whereby the system analysis the electricity consumption of a customer on a monthly bases. If the system identifies that there is extreme high or low usage of electricity it will show a notice.

If the system identifies that the electricity usage was very high it will recommend the artisans to check the gadget for fault and in case the gadget is found fault the gadget will be replaced. If the system identifies that there is extreme under usage of electricity, the system will recommend the

artisans to check if the gadget was tempered with or if its fault. This will reduce either overcharging or undercharging customers.

2.3 ANALYSE FEASIBILITY

Leedy (2013) posits that feasibility analysis encompasses evaluating the success of a project taking into account various factors which include technological, scheduling and economic. The researcher successfully carried out feasibility analysis on the proposed system and concluded that it was worthwhile to proceed with the project. Outlined below are different feasibility analysis aspects employed to investigate whether it is feasible to continue with the project of not.

2.3.1 TECHNICAL FEASIBILITY

Leedy (2013) claims that technical feasibility is a process whereby the project developer assesses the logistics needed to develop a project such as materials, labor skills and technology. Technical feasibility is going to be explained by looking at the technologies and technical expertise already available or that can be easily acquired at ZETDC.

2.3.1.1 TECHNICAL EXPERTISE

ZETDC already have the IT personnel therefore the proposed system could be developed from within. However the personnel at ZETDC are keen to learn new ideas from the outsiders so they urge outsiders to come up with proposals which can help the organization to improve its business processes. This enables ZETDC to embed the proposed system with the already existing system in order to improve service delivery and easily manage energy meters.

2.3.1.2 HARDWARE AND SOFTWARE REQUIREMENTS

Henry (2010) defines hardware as tangible elements of a computer which include system unit, keyboards, mice, monitor and central processing unit. Software was also defined as instructions that make the computer work. Table 2.1 below shows the hardware and software components needed to come up with the proposed system.

Table 2.1: Hardware and Software requirements

Description	Quantity Needed/ expected	Quantity Available	Remarks
Hardware Needed			
Ink jet printer	3	2	2 printers need to be acquired
HP laptops	4	2	3 HP laptops are needed
Router	2	1	1 additional router is required
Switch	2	1	1 Required
Network cables	150m	Nil	150 m should be acquired
1TB External hard drive	2	1	1 is needed for backup
Software needed			
Apache Server	1	Nil	1 Required
MySQL relational Database	1	Nil	1 Required

2.3.2 ECONOMIC FEASIBILITY

Palm (2014) defines economic feasibility as analyzing revenues expected from the project and the costs of running the project in order to ascertain if it is worth to carry on the project. The project can only proceed if the benefits are more than the costs of carrying the project.

2.3.2.1 COSTS

Butt (2014) claims that project costs are those expenditures that are incurred during and after the development process of a project. System developers strive to reduce project costs because these costs have a negative effect on the project development process. In worst cases a project may fail because of project costs.

2.3.2.2 DEVELOPMENT COSTS

Hofstrand (2016) posits that development costs are those costs which are incurred during project development. Table 2.2 shows the software and hardware costs to be incurred during

development of the energy meter management system.

Table 2.2: Development Costs

Component	**Quantity Required**	**Price $US**
Hardware Needed		
HP Laptops(core i7)	2	900
External hard rive	1	100
Ink jet printer	1	340
Network cables	150 meters	300
Wi-Fi Router	1	50
Switch	1	800
Software Needed		
Apache server	1	Open Source
MySQL Relational Database	1	Open Source
Total		**2450**

2.3.2.3 OPERATIONAL COSTS

Gao and Rusu (2015) posit that operational costs refer to the costs incurred during system development. These include stationary, hardware repairs, system maintenance, staff development and internet bills. Operational costs can be categorized into two: direct operational costs and indirect operational costs. Table 2.3 presents the operational cost to be incurred during the development of the energy meter management system.

Table 2.3: Operational Costs

ITEM	COST		
	Year 1	**Year 2**	**Year 3**
Internet bills	40	40	40
Staff development	3000	2000	2000
Hardware repairs	200	400	700
Stationary	50	30	20
System maintenance	100	200	300
Total costs	**3350**	**2670**	**3060**

2.3.2.4 BENEFITS

Benefits are positive outcomes that accrue or are enjoyed or experienced after implementing the developed system (Kyte and Kuhn, 2014). Benefits are divided into two categories: tangible and intangible.

2.3.2.5 TANGIBLE BENEFITS

McNabb (2014) defines tangible benefits as those benefits that are measurable in monetary terms and accrue as a result of implementing a project. System developers should develop a computerized system that benefits and add value to the organization. Table 2.4 presents tangible benefits that are expected from the proposed energy meter management system.

Table 2.4: Tangible benefits

BENEFIT	**Year 1**	**Year 2**	**Year 3**
Reduced transport expenses	3950	2 290	2800
Reduced labor costs	1800	700	800
Reduced telephone bills	1000	1000	1100
Total Benefits	**6750**	**3990**	**4400**

2.3.2.6 INTANGIBLE BENEFITS

McNabb (2014) outlines that intangible benefits are those benefits that cannot be expressed in monetary terms but add value to the organization. Intangible benefits are considered when analyzing how successful the project is. They contribute to the image of the project. By introducing an electronic energy meter management system, ZETDC is going to enjoy the following benefits:

- Addition of value to the system.
- Workers get motivated by using a computerized system.
- Decisions are provided based on the problems identified.
- Problems are shown instantly once they are identified.

2.3.2.7 COST BENEFIT ANALYSIS

Palm (2016) defines cost benefit analysis as a process of comparing the benefits to be enjoyed from the project versus the costs to be incurred during development and implementing the project. If the benefits outweigh the costs, the project is considered worth to continue and if the costs outweigh the benefits, the project cannot be continued. Table 2.5 shows cost benefit analysis of the electronic energy meter management system for three years.

Table 2.5: Cost Benefit Analysis

COSTS	**YEAR 1**	**YEAR 2**	**YEAR 3**
Costs of developing the system	2450		
Costs of operating the system	3350	2550	3060
Total costs	**(5800)**	**(2670)**	**(3060)**
Tangible benefits expected from the system	6750	3990	4400
Intangible benefits expected from the system	-	-	-
Total benefits expected from the project	**6750**	**3990**	**4400**
Net benefits expected from the project	**950**	**1320**	**1340**

2.3.2.8 INVESTMENT TECHNIQUES

Investment techniques are the accounting methods that are used to measure the success of the project (Palm, 2016). These accounting methods usually express the measurements in monetary terms and include net present value, average rate of return and payback period.

2.3.2.8.1 RETURN ON INVESTMENT (ROI)

Palm (2016) claims that Return on Investment (ROI) is an accounting measuring technique that compares the gains obtained from the project as well as the loss generated with relative to the invested capital. The formula for calculating Return on Investment (ROI) is as shown below.

$$\textbf{Return on investment} = \frac{\text{Total benefits} - \text{Total costs}}{\text{Total costs}} * 100$$

Year 2019

$$\frac{6750 - 5800}{5800} * 100$$

= 16. 3

Year 2020

$$\frac{3990 - 2670}{2670} * 100$$

= 49. 4

Year 2021

$$\frac{4400 - 3060}{3060} * 100$$

= 48.

2.3.2.8.2 **THE PAYBACK PERIOD**

Payback period is the time taken, expressed either in months or years, by the generated cash inflows to cover the project's initial capital (Shelly and Rosenblatt, (2013). The payback period

is also viewed as the time required by the project to break even. Table 2.6 shows the expected annual cash flows from the proposed energy meter management system.

Table 2.6: Payback period

YEAR	ANNUAL CASH FLOW	CUMULATIVE
0	(40 000)	(40 000)
1	5 000	(35 000)
2	15 000	(20 000)
3	20 000	--
4	30 000	30 000

The project is expected to bring back the initial capital in 3 years, therefore the project is considered less risk to invest in.

2.3.3 SOCIAL FEASIBILITY

Shelly and Rosenblatt (2013) defined social feasibility as measuring the impact, considering morals and ethics, the project will have on the society and various stakeholders that are affected with the development of the system. The system will have both positive and negative effects to its stakeholders and these include:

- The clients of ZETDC benefit from the system through having their prepared meters audited for faults.
- The community is going to benefit from expertise knowledge provided by the system on how to handle energy meters and how to save electricity usage.

2.3.4 OPERATIONAL FEASIBILITY

McNabb (2014) claims that operational feasibility entails forecasting the capability of supporting, utilizing and performing activities of a project. Both users of the system and the system developers are involved. The source code of the entire system will be provided so that the system operators will be in a position to maintain the system as well as upgrade the system. The system makes use of an interactive interface so as to make it easy to use and reduce wasting of time in consultation on how to carry out certain tasks on the system. The system developers have

knowledge of how the entire system work so they will carry out workshops with the system users where they will equip the system users with knowledge on how to effectively operate the system.

2.4 RISK ANALYSIS

McNabb (2014) posits that risk analysis is a process of analyzing and determining the possible negative impacts that may be experienced as a result of carrying on a project as well as assessing the extent of the impacts. Risk analysis is categorized into two categories: qualitative and quantitative analysis. Quantitative analysis entails numerically determining the probability that a certain negative impact can be experienced. Qualitative analysis does not numerically determine the probabilities but outlines the threats and their effects as well as suggesting counter measure to prevent those threats. Performance, technical, implementation and economic risks may be encountered during and after project implementation.

2.4.1 TECHNICAL RISKS

Henry (2010) claims that technical risks are those risks that are experienced after execution of a technical process. These risks usually emanate from faults in technical procedures, engineering and in design. Periodical database backup, through the use of software utilities, should be done to prevent data loss.

Malicious software can cause system failure through corrupting system files; therefore software engineers should make sure that all computers are manned with up to date antiviruses. Antiviruses should be installed before implementing the system and these antiviruses should be periodically updated to ensure maximum protection.

Another risk which can be experienced once the system is operational is hacking. Hackers can expose confidential information of the organisation if the gain access into the system. Firewall should be implemented to avoid hacking. Strong passwords which are at least 8 alphanumerical characters should be advised. System users should be encouraged not to share their password and also to periodically change passwords. Password recovery should be done in a more secure way which includes using emails.

2.4.2 ECONOMIC RISKS

Stanlake (2012) defines economic risks as the probability that the revenue to be generated by the project will not be able to repay the debts acquired during project development and all other development expenses. The project may fail if the amount budgeted for the project is less than the actual expenses incurred during development and after implementation. In other cases this may delay project delivery time. To cater for economic risks project managers should structure a flexible budget that can be easily adjusted to suit current project needs.

2.4.3 PERFORMANCE RISK

Roger (2015) defines performance risk as the probability that the project will bring negative effects to the organisation through either failing to meet business objectives or through not supporting day to day business operations. The organisation may incur additional switching costs if the project fails to meet its objectives. In order to reduce performance risks, system developers should periodical consult system users and provide them with system prototypes before implementing the final project.

2.4.4 IMPLEMENTATION RISK

Stanlake (2012) defines implementation risk as the probability that the developed system may malfunction upon implementation. If there is complexity in system implementation, the system users may resist using the system and calls for continuation in the use of the old one. In order to reduce implementation risk, system developers should use parallel changeover strategy where the newly developed system is run side by side with the old one so that users can have a better view of how the new system make their operations easier.

2.5 STAKEHOLDERS ANALYSIS

Potter (2010) claims that stakeholders are those people who are either directly or indirectly influenced or who can influence the system processes. The community, project managers, system developers, system users, and employees are all stakeholders who will either affect or be affected by the electronic energy meter management system.

2.5.1 MANAGEMENT

The management always expects the system to meet the objectives of the organization by supporting its vision, mission statement and the core values. The management expects a better business IT/IS alignment after system implementation through supporting day to day business operations. The management should acquire adequate resources to be used to develop the system and others to be used after implementation phase. These resources include, but not limited to, financial resources, human resources and capital base. Resources should be appropriately allocation to all phases of system development and should tally with the budget.

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2.5.2 SYSTEM USERS

The interest of the system users should be taken into consideration during the system development process. The system users want the system to meet all their expectations and to less complicate to use. They also expect that the newly developed system will curb all the challenges associated with the old system. The interfaces of the system should not use bright colors and well designed. It should be self-explanatory showing clear labels and textboxes as well as clear messages. System developers should respect users' needs to avoid resistance.

2.5.3 EMPLOYEES

System developers should also consider the interests of the employees when developing the system. This is because if the system does not tally with the interests of the employees, they may resist the system. Employees would like to know if the proposed electronic energy meter management system will not compromise their job security and positions. The system will not lead to retrenchment of employees because it will only provide an easy way to audit energy meters based on electricity consumption.

2.5.4 COMMUNITY

The community may sometimes be affected by the development of the system. The community expects that if they are being affected the effects should be positive. They would like their ethics and social morals not to be violated. System developers should take into account and consider the community to make sure that the newly developed system would be socially acceptable.

Computerised systems may provide technical IT skills to the community especially if the members of the community have access to the system.

2.5.5 SYSTEM DEVELOPERS

These are responsible for transforming the idea of the researcher into a software product. Developers anticipate that researcher's idea is clear and understandable for the system to be easily and quickly delivered to its end users. The developer also anticipates realist expectations from the users. They expect persistence in their requirements to facilitate delivering of quality product. Developer interests should not be overlooked since they are directly related with system development.

2.6 WORK PLAN

Roger (2015) defined a work plan as a written document which shows tasks or phases of a project and the period on which they should be accomplished. The work plan for the electronic energy meter management system shows that the phases are carried out one after another except for the project documentation which is carried out simultaneously with all other phases. Table 2.7 shows the work plan for the proposed system.

Table 2.7: Work plan

Events	Start Date	End Date	Duration(days)
Project Proposal	05- 01-19	19 - 01-19	14
Planning Phase	20-01-19	09 - 02-19	21
Analysis Phase	10-02-19	02 - 03-19	21
Design Phase	03-04-19	23 - 04-19	21
Implementation Phase	24-04-19	08 - 05-19	14
Project Documentation	05- 01-19	07 - 05-19	For each activity
System Maintenance	07-05-19	--	On going

2.6.1 GANTT CHART

Hughes (2011) defines a Gantt chart as a tool that shows schedules for a project highlighting the start date and end date for each activity. Fig 2.1 illustrates the schedules of the activities to be carried out in developing the electronic energy meter management system.

Events (Weeks)	1	2	3	4	5	6	7	8	9	10	11	12
Project Proposal												
Planning Phase												
Analysis Phase												
Design Phase												
Implementation												
Project Documentation												
System Maintenance												Ongoing process

Fig 2.1: Gantt chart

2.7 CONCLUSION

The researcher has successfully carried out the planning phase and has highlighted all the inputs that are expected for the project to be successful. The feasibility studies carried out show that it is worth to carry on with the project as it proved to be economically, socially, operationally and technically feasible. The cost benefit analysis carried out shows that the benefits to be obtained from the system outweigh the costs of developing and running the system so it is worth to continue developing the system. The researcher drafted the work plan of the system and reviews that it may take up to 6 months to develop and produce a documentation of the system. Having completed the planning phase, the developer can move on to the analysis phase. The next phase will look at the weaknesses of the current system.

CHAPTER 3 ANALYSIS PHASE

3.1 INTRODUCTION

Project analysis is problem solving technique used in system development processes and decomposes a system under development into its component processes with the aim of articulating how the system components are related to each other to come up with a complete system (McMullan, 2010). Analysing the system is a very important aspect in system development as it breaks down the whole project into segments and make an individual segment assessment to identify how each segment co-function with the other system segments. System analysis explores how the proposed framework will be suitable in covering and including customer needs and stakeholders' expectations in the development of the proposed system. Interviews, questionnaires and observation were used to collect data and the merits and demerits of each of these data gathering methodologies were discussed. Different alternatives which could be used to acquire the proposed system were also discusses which included improving the existing system, outsourcing and in-house development. The Chapter ends with a conclusion.

3.2 INFORMATION GATHERING METHODOLOGIES

Different information gathering methods were employed in order to have a better view of how the current system works and the problems that arise as a result of using this system. These data gathering methodologies were:

- Interviews
- Questionnaires
- Observations

3.2.1 INTERVIEWS

Laudon (2018) posits that an interview is a shared conversation between two or more people held with the aim of acquiring research data which fulfils research objectives. The interviewer organizes the interview session and should make sure that the questions are clear in order for the interviewee to give standard responses. Telephone interviews and face to face interviews are common used to get information from the interviewee (Kendall and Kendall, 2015). The researcher made use of face to face interviews in order to take note of reactions and body

language from the interviewee. Face to face interviews were preferred because they were less costly as compared to telephone interviews. The researcher managed to hold shared conversations with the operations manager and the managing director of ZETDC in a quest to find out how the management view the value of the existing system and how the system affected their day to day business processes. Most managers at ZETDC Southern Region offices were interviewed and each interview session to between ten to fifteen minutes. The interview questions were mainly centered on how the artisans get notice if there is a gadget fault, which communication methods are mainly used by customers to report if they suspect that their energy meters are not well functioning, whether there are any cases recorded on customers who temper around with energy meters with the aim of reducing electricity expenses, how frequent did they get fault energy meter reports from customers and the main factors which contribute to high rates of fault energy meters.

3.2.2.1 ADVANTAGES OF INTERVIEWS

- The use of interviews facilitates the obtaining of crucial information through in-depth analysis of the research and making further clarifications to enable the interviewee to understand the questions and provide standard answers that can be used in the research. The researcher preferred to use unstructured interview questions in order to provide liberty to the interviewee to provide as much information as he / she could. This also helped the researcher to provide further clarification whenever the need arose.
- Interviews helped the researcher to obtain as much detail as he could because of the high response rate obtained and also because the respondents were keen to provide answers to all the asked questions.
- Incomplete answers and ambiguities were clarified and this enabled fluent progression of the interview sessions.
- Interview questions were structured to cover the whole physical setting of the current system in place and this enabled the researcher to obtain the much needed information regarding the current system.

3.2.2.2 DISADVANTAGES OF INTERVIEWS

- The researcher found it difficult to interview the targeted group although he managed to hold all the scheduled interview sessions. The staff member were most of the time busy doing their day to day duties so the researcher had to be patient enough to interview them whenever they got free time.
- The use of unstructured interviews was sometimes misleading as the respondents often provided responses which were not suitable for this research.

3.2.2 QUESTIONNAIRE

A questionnaire is a set of structured questions formulated by the researcher and given to the respondents with the aim of collecting adequate information which can the used in the research study (McMullan, 2010). Open and closed ended questionnaires are the two categories of questionnaires. Closed ended questionnaires do not give the respondents liberty to explore his or her full expressions as he or she should provide either a yes or no as the answer. Open ended questionnaires give respondents room to express thoughts, opinions and ideas without restriction (Kendall and Kendall, 2015). All the questionnaires were given to the subordinates because interviewing all employees could consume a lot of time and could took more than a day to complete the research. All the questions which constitute the questionnaire are attached in the supplementary section which is in appendix D of this documentation. The validity of the responses was enhanced by ensuring the respondents to answer the questionnaires anonymously. Respondents were also assured that their responses were only going to be used for academic purpose and will be kept confidential.

3.2.3.1 ADVANTAGES OF QUESTIONNAIRE

- The use of questionnaires increased the possibility of getting accurate and valid information as the respondents answered the questionnaire anonymously.
- Questionnaires were reliable and flexible to use because they did not require immediate response. The respondents answered the questionnaire on their free time and even during odd hours.

3.2.3.2 DISADVANTAGES OF QUESTIONNAIRE

- The researcher may obtain invalid responses from the respondents if they fail to interpret the questions.
- There were higher chances of obtaining vague responses because the respondents answered the questionnaire anonymously.

3.2.3 OBSERVATIONS

McMullan (2010) claims that observation is a process whereby the researcher observes how the system works. Observation also entails taking note of the physical setup of the system, noting the natural setting of the physical features, assembling of data through taking note of various system events as well as inspecting how the system behaves. Observing the system to obtain information about how it operates noting down unfavorable outcomes is known as overt. Covert is a process of observing the system without users knowing that they are being observed. The researcher made use of both covert and overt to observe how the current system works. By the time covert was used system users did not change their behavior because they were not aware that they were being observed. The researcher noted down how frequently energy meter faults were reported, how these faults were recorded, how the enquiries department coordinated with the operations department to get reported faults resolved and how faults reports were generated. This information was enough for the researcher to investigate the areas where improvement could be made. Observation was carried out to supplement the interviews and questionnaire in order to ensure data validity and reliability. The data obtained from questionnaire and interviews was compared with the data that was generated through observation to verify if the data do not contradict.

3.2.3.1 ADVANTAGES OF OBSERVATIONS

- By observing how the current system operates the validity of the research is enhanced and the data obtained is more accurate than that which is obtained through interviews and questionnaires.
- Observations helped the researcher to obtain enough data on how the various activities concerning managing energy meter reports were coordinated. This was achieved through examining how the staff were doing their duties.

- The users reaction towards how the system operates was noted and this added flesh to the data generated through observation

3.2.3.2 DISADVANTAGES OF OBSERVATIONS

- The data obtained from observation through the overt method might not be valid because usually employees change their behaviour if they know that they are being observed and usually pretend to do their obligations efficiently.
- Observing the whole system may be time consuming because it may take more than a day and in other cases three days to fully observe how the system works. More complex systems may even require a week to observe the full system. The researcher may at times not be given access to observe some parts of the system which the management might think is private and confidential as that part for producing reports. This will be a drawback to the research study.

3.3 ANALYSIS OF EXISTING SYSTEM

On the current system customers have to physically visit the ZETDC offices to report for energy meter faults. They may also report the faults via phone calls. The problem that arises is that the customers only report if they discover that the gadget is recording that they have used more electricity than they actually used. If the gadget records that they have used too little electricity than they actually used, customers will not report such faults because they will be benefitting from such faults. Therefore customer only report faults which cost them and do not report faults which put them on the advantage. In other case customers may not even know that their energy meter gadget has a fault. Because the current system relies on faults reported by customers, ZETDC is finding it difficult to identify fault energy meters that have not been reported by the customers. Sometimes it is also difficult to identify those electricity energy meters that have been tempered around by the customers. The system processes can be summarised as follows:

Inputs: Reporting faults noticed on electricity energy meters

This is achieved through customers physically visiting the ZETDC offices to report for faults or customers notifying ZETDC through phone calls.

Processes: include receiving faults notices and recording these faults in the books waiting for action to be taken and for future reference. The details that are recorded include customer name, the date on which the fault notice was received and the problem which the gadget is experiencing. The faults received are then forwarded to the supervisor of the operations department who will then assign artisans to go and investigate the problems on the garden. After problem identification, the energy meter is then fixed.

Output: Fault records

The output of the process include electricity energy meter fault records, fault reports, number of gadgets with were tempered with, number of gadgets which were either undercharging or overcharging customers, gadgets fixed and pending gadgets.

3.4 THE ANALYSIS PROCESS

Hughes (2011) claims that the analysis process is a system analysis phase which involves identification of system functions, noticing the movement of data from one entity to another and generally have a view of how the system performs. The following are encompassed in process analysis:

- Identification of the current system's inputs and outputs.
- Identification of relationships on system activities.

3.4.1 EXISTING SYSTEM ACTIVITY DIAGRAM

Brolser (2015) posits that an activity diagram is a diagram that shows the setup of the current system framework. It shows the movement of data from one entity to another highlighting the sequence of processes from the first process up to the last. Illustrated below is an activity diagram of the current system.

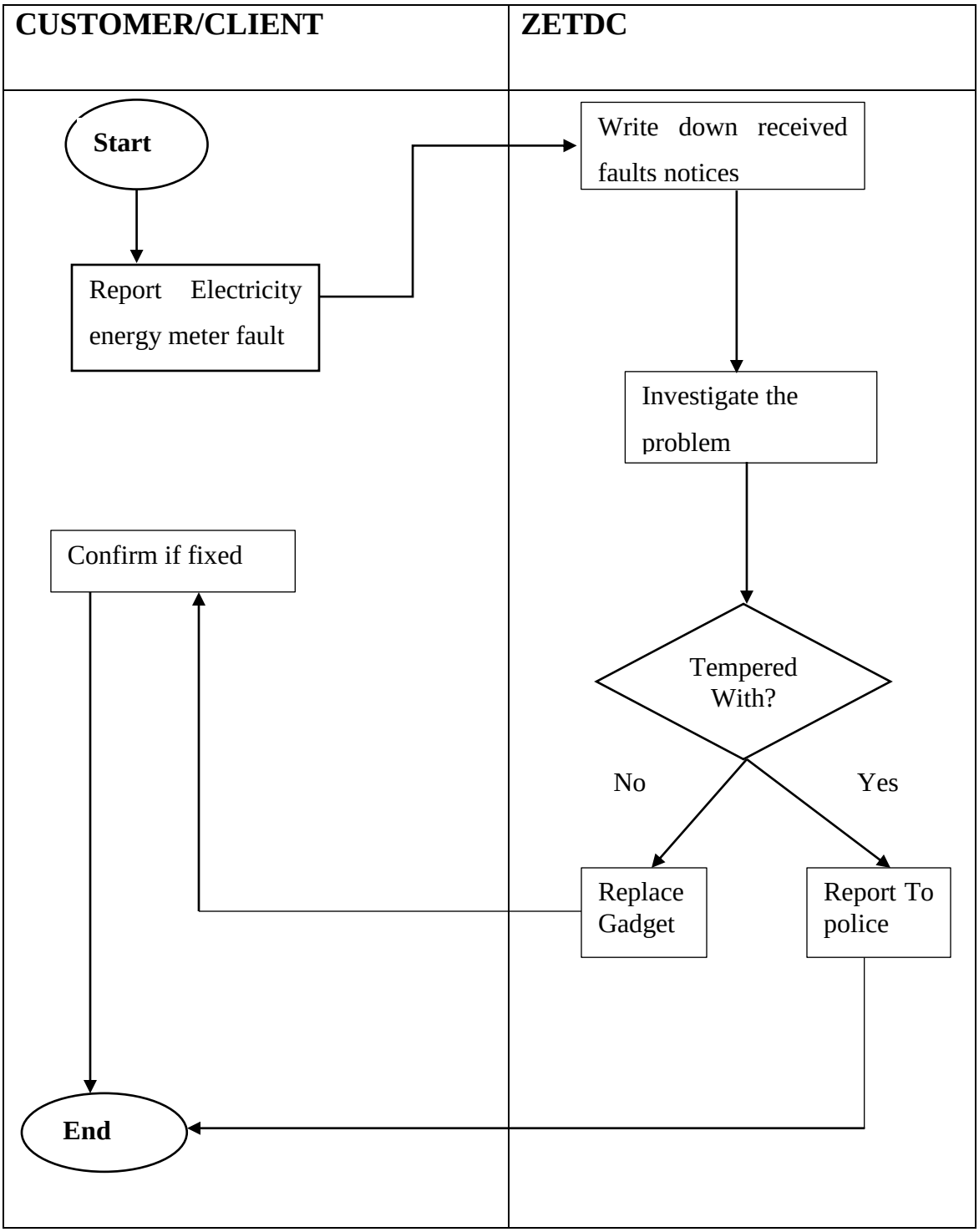


Fig 3.1: Activity diagram of the current system

Key

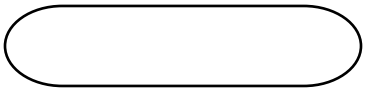
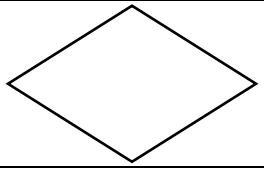
Symbol	Description
	start/end
	Decision
	Activity
	data flow arrow
	Documentation

Table 3.1 key symbols

3.5 DATA ANALYSIS

Brolser (2015) posits that data analysis involves logical thinking and the practice of investigation whereby the data is evaluated through inspecting all elements of the data which has been delivered. Data gathered through the use of questionnaires, interviews and observations were used to model the current system. The researcher also used the context and data flow diagrams to model the current system.

3.5.1 CONTEXT DIAGRAM OF THE CURRENT SYSTEM

Shelly and Rosenblatt (2010) defined a context diagram as a diagram that shows the interfaces and boundaries of the current system or the proposed system. The contexts diagram also highlight how the system is related to its external factors by showing the inputs from external

factors and the outputs to external factors. These inputs and outputs from and to external factors represents the interests of how various stakeholders can influence or be influenced the existing or proposed system. Fig 3.2 show below is a context diagram of the current energy meter management system and shows how the customers make use of the current system in place and also how the staff at ZETDC also makes use of this system.

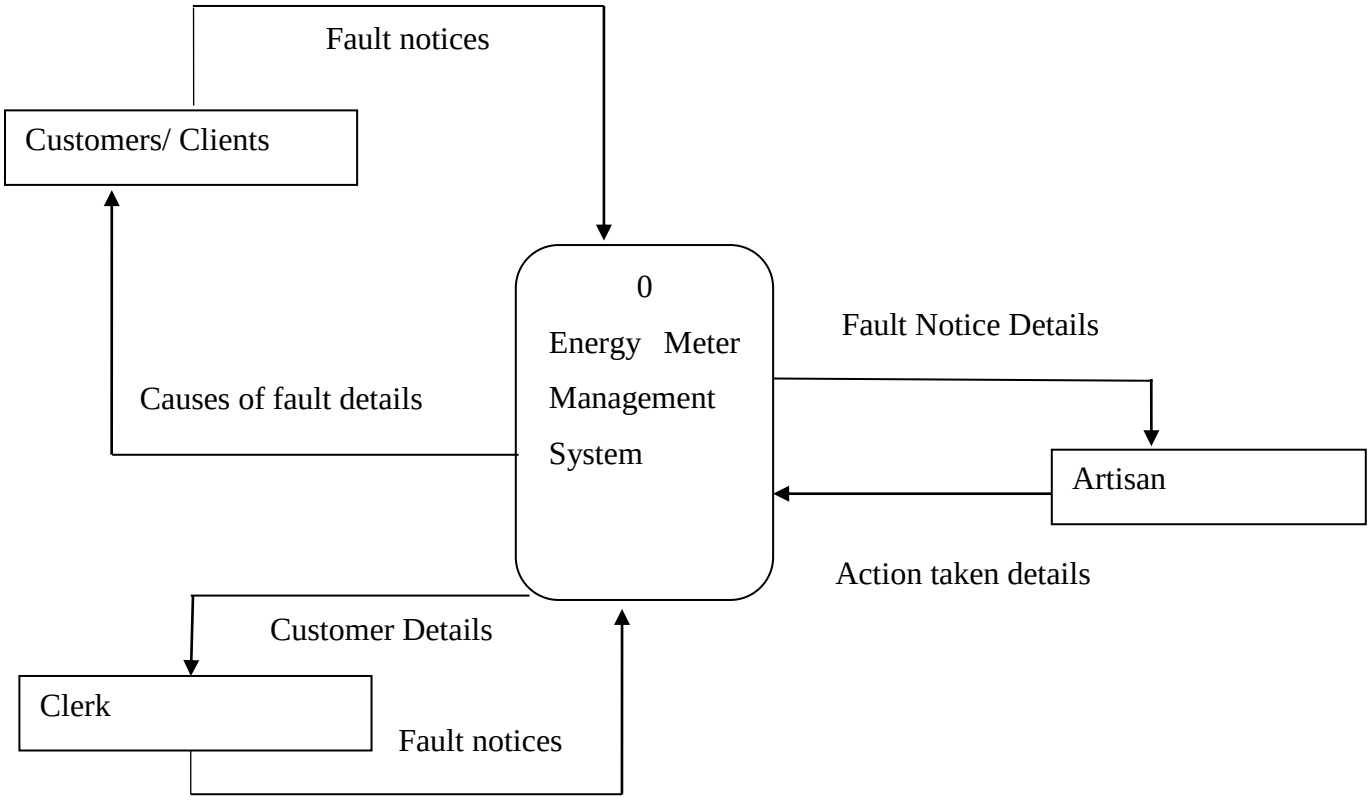
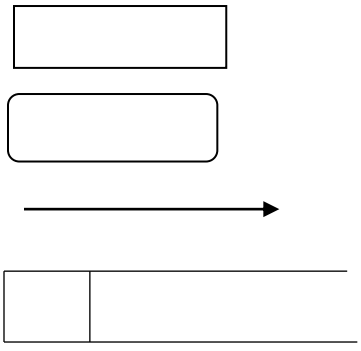


Fig 3.2 Context Diagram of the Current System

Key for the Contexts diagram and the Dataflow diagrams



3.5.1 DATA FLOW DIAGRAM OF THE CURRENT SYSTEM

Butt (2014) claims that a data flow diagram is a diagram that shows the various entities of the system as well as the inputs from these entities and how they are processed or manipulated so as to produce system outputs. The data flow diagram shows in sequential form the each system process and the flow of data. Each process will have its inputs and output and usually the output of a process is the input of the next process. The data flow diagram also shows where data can be stored. Fig 3.3 is a data flow diagram of the current system.

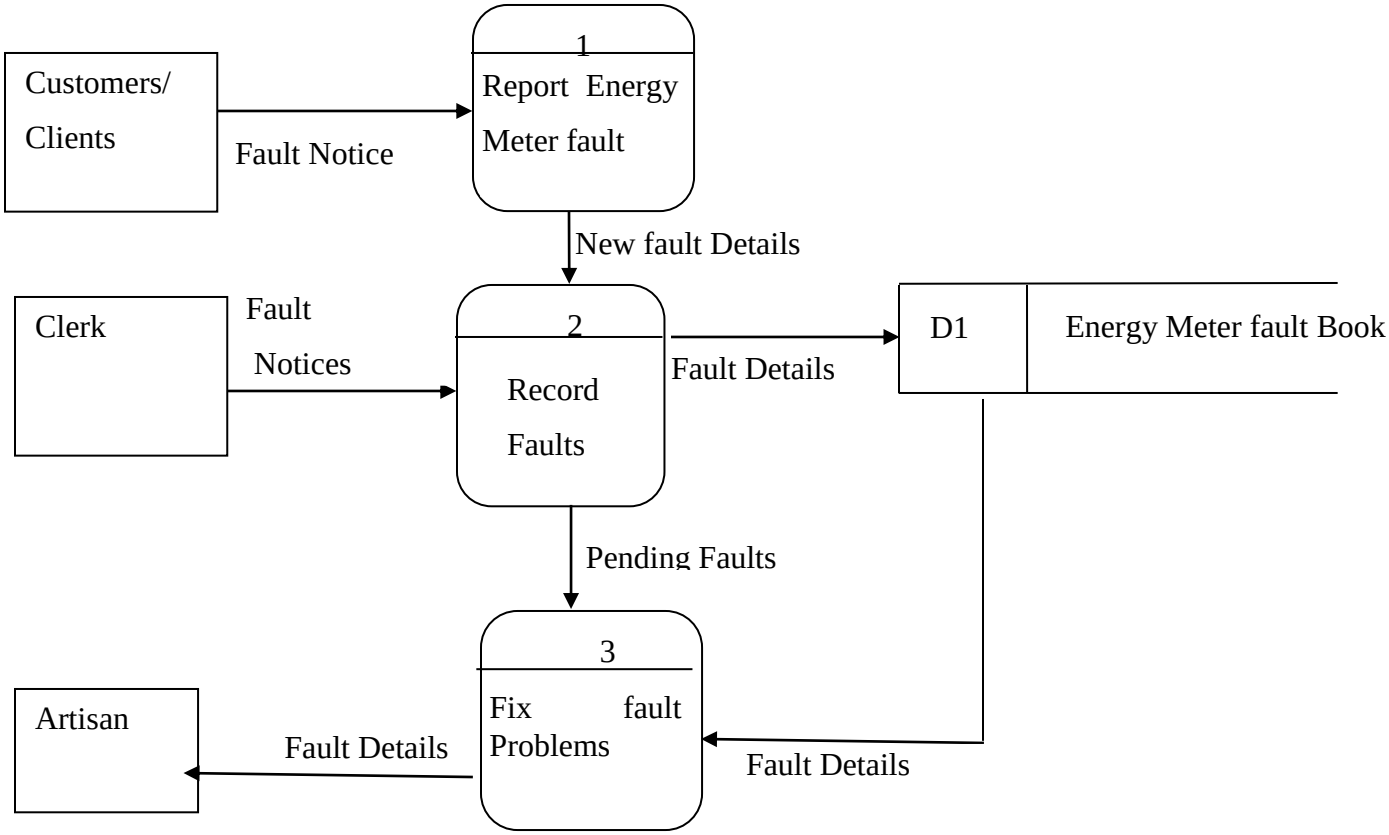


Fig 3.3: Data Flow Diagram of the Current System

3.6 CURRENT SYSTEM SHORTFALLS/DEMERITS

- ZETDC can only have knowledge of the energy meters through reports from clients and does not have any other method to know which energy meters are experiencing faults.
- Many ZETDC customers are tempering around with the energy meters because there is no monitoring of energy meters.

- Customers usually do not report faults if they noticed that the fault is giving them advantage of spending less on electricity.
- Customers may find it costly and time consuming to travel to ZETDC offices so this may result in some fault energy meters left unreported. This can also happen if the customers do not have contact details of the ZETDC staff.
- Lack of energy meter monitoring system can violet the goals of the company as well as its mission, vision and core values.
- The faults records are recorded in exercise books so there is lack of security and confidentiality as the records are prone to misuse by the staff members.
- Reports for a specific period are not automatically generated so the manual generation of reports is tiresome and time consuming.

3.7 EVALUATION OF ALTERNATIVES

Butt (2014) defines evaluation of alternatives as a process in project development that encompasses weighing various methods of acquiring a system taking into consideration the costs of acquiring the resources, the resources available at the organization as well as the time frame it may take for the system to be developed. The researcher weighed the three alternatives which were improving the existing system, in-house development and outsourcing. The intention of the researcher was to choose the alternative which had the highest advantage over the others.

3.7.1 OUTSORCING

Butt (2014) posits that outsourcing a method of acquiring a software from outsiders through agreements with externals. The software may be acquired even from abroad or from local firms who deal in software development projects. This method of acquiring software's is preferred by many organizations because all the risks associated with the development process are taken by the supplier of the software. The external suppliers usually will have vast experiences in system development and can provide world class software which may be beyond the uses' expectations. They will also provide the system documentation so that if the need arises, the users of the system can refer to the user manual. The suppliers of the system will be responsible for training all the staff that will use the system. They will also specify the minimum hardware requirements of the system so that if the available hardware is not compatible with the software then

appropriate hardware will need to be acquired. The suppliers of the system will make sure that the working environment of the system is at its best and all system security measures are put in place. They will also provide information on how the system can be maintained so as to provide the much needed efficient in supporting business processes.

3.7.1.1 ADVANTAGES OF OUTSOURCING

- The development of the system will not disturb day to day duties of the staff members as they don't have to participate on the development process.
- There are very high opportunities of acquiring quality software's if the organisation managed to contract reputable firms.

3.7.1.2 DISADVANTAGES OF OUTSOURCING

- A lot of time may be needed to train the system users on how to use the system. This is because the system will only go into the hands of the users after its completion. Training time will disturb day to day duties of the staff
- System suppliers may fail to develop the system in the stipulated time because they may have too many customers to which they are contracted to and have too many projects to concentrate on.

3.7.2 IMPROVEMENT

Shelly and Rosenblatt (2010) posits that improvement is whereby the system become more valuable than before. This is achieved through adding more features to the system and updating the software version through the process of upgrading. ZETDC have many options of acquiring a better system than the one they have. They may prefer to upgrade the current system through computerizing certain system modules. Improving the existing system will not totally solve the challenges that are being currently faced because some processes will remain unchanged. Improving the current system will results in costs such as networking costs whereby the organization will need to acquire routers as well as network cables, switches and bridges. The organization will also need to acquire computers which will be used in certain departments where improvements are made. This may demotivate those staff who will still be using those modules of the system where no improvement is made.

3.7.2.1 ADVANTAGES OF IMPROVEMENT

- Improving the current system may be less costly to the organisation provided that few modules will only need some changes
- Improving the existing system can lead to lower staff training costs because those staff who work with those modules which are not affected by the upgrade process will not need any training; training will only provide to those who work with upgraded system modules.

3.7.2.2 DISADVANTAGES OF IMPROVEMENT

- Improving the existing system may not bring new ideas since the process is carried out by the employees in the organisation.
- The employees may not be skilled enough to bring out valuable and sound system changes.

3.7.3 IN-HOUSE DEVELOPMENT

McMullan (2010) defined in-house development as a method of acquiring a system whereby the employees of the origination will develop the system with the view that they will be able to produce a system that will help in achieving business objectives as well as be in line with the vision, mission and core values of the organization. If the system is developed internally there are higher opportunities of developing the system which will improve business processes since the developers will have more knowledge on how aspects of work are carried out as well as all processes that need to be taken into account.

3.7.3.1 ADVANTAGES OF IN-HOUSE DEVELOPMENT

- If the system is developed by internal developers, ZETDC will have total control of the system and can customise it in the way they like.
- If the system is developed by internal developers, there are higher chances of developing a system that will be in line with the vision, mission and core values of the organisation as well as fulfilling the organisation's requirements

3.7.3.2 DISADVANTAGES OF IN-HOUSE DEVELOPMENT

- In-house development may lead to the development of less quality system because organisation's employees will not bring new ideas.
- In-house development may disturb employees from carrying out their day to day duties since they have to balance time between developing the system and carrying out day to day duties.

Table 3.2 Alternative Evaluation

Alternatives	**Estimated Costs**
Outsourcing	$9 500
In house development	$7 000
Improvement of the existing system	$7 500

As shown in Table 3.1, it can be learnt that it is ideal for ZETDC to acquire a new system through in-house development because this method is less costly as compared to improving the existing system and outsourcing. ZETDC already have an IT department with skilled workers who are capable of developing the proposed system.

3.8 REQUIREMENTS ANALYSIS

Shelly and Rosenblatt (2010) claims that requirement analysis is a process in the development of a system whereby the users requirements are identified as well as ascertaining how these requirements can be achieved. The developers of the system and the users of the system should meet a consensus on the functions that the system should provide or support. After meeting the consensus it will be an obligation to the system developers to develop a system that meets the ascribed functionality in the stipulated or agreed time frame. Functional and non-functional are the two categories of the requirements.

3.8.1 FUNCTIONAL REQUIREMENTS

Shelly and Rosenblatt (2010) posit that the functional requirements of the system are the functionalities that are needed to be provided by the system. The users of the system will lay down what they expect from the system and they should agree with the system developers on the

requirements. The system developers need to development the system adhering to the system requirement. The electronic energy meter management system is expected to show customers that are extremely using either more or less electricity. This will call for the artisans to check suspected energy meters for fault.

3.8.1.1 Use Case Diagram of the Proposed System

Use case diagrams highlight the activities of the system from a user's point of view. It also presents the interaction that exists between different roles and different functions of the system. It is referred to as the upper level view of the system, valuable exclusively when presenting to different stakeholders. Use case comprises of four objects which are the actor, use case as well as the system and association. **Fig 3.3** shows a use case diagram for the proposed system.

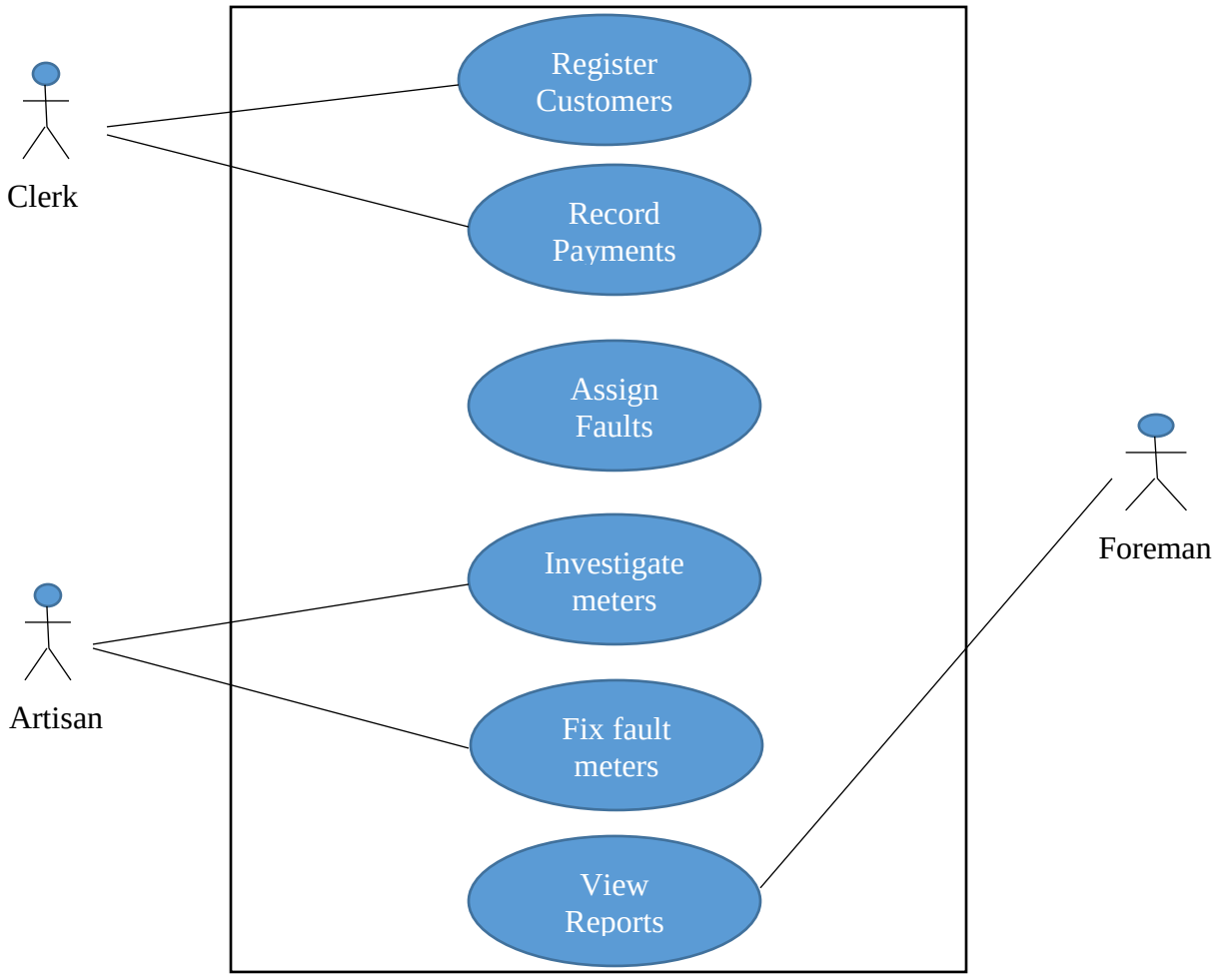


Figure 3.3: Use Case Diagram for the proposed

3.8.2 NON FUNCTIONAL REQUIREMENTS

Non-functional requirements are those elements of the system that adds value to the system and support functional requirements of the system (Shelly and Rosenblatt, 2010). Non-functional requirements mainly focus on usability of the system. The system need to have a good graphical user interface with clearly label command buttons and labels. Bright colors should be avoided where ever possible since they may impose eye sight problems to the system users. The system should be efficient in both saving data to the database and accessing data from the database. Instant search results should be accomplished and different search criteria's should be available to the system users. The system should be error free and provide appropriate messages whenever it detects data which is not in the right format. The system should ensure data security through the use of sessions, cookies and authentication. Users should have different access levels. It should be easy to add new modules and functionality on the system. This can be achieved through the use of object oriented programming languages which supports the use of classes, inheritance, and polymorphism and data abstraction.

3.9 CONCLUSION

Interviews, questionnaires and observation were used to gather data on how the current system works. The current system experienced a lot of challenges which include being manually oriented resulting in higher stationery costs and lack of automatic gadget monitoring. The users of the system need a system that will not complicate organization's processes and a system with a good user interface. ZETDC had a lot of alternatives to use to acquire a new software which include improvement, outsourcing and in-house development. Among these ZETDC has opted to acquire the new system through in-house development. The next chapter is the design phase where the architectural and database design of the system is explored.

CHAPTER 4: DESIGN PHASE

4.1 INTRODUCTION

This chapter focusses on the system designs as well as the functional and non-functional requirements stipulated by the system users so as to achieve the system objectives. The system to be developed should provide all the functionality needed as well as meeting the needs of the users. All the questions that the users may raise should be answered by the system. The functional requirements stipulated by the system users should be adhered to and the system design should clearly show the system boundaries as well as the roadmap of how the various development processes will be carried out. The design of the proposed system will show the expected system input and output interfaces as well as the tools of the interfaces which include the textboxes, labels and command buttons. The architectural and database design are also going to be explored.

4.2 SYSTEM DESIGN

Kendall and Kendall (2012) claim that system design is a process in the development of a system whereby the system developers create identifies various system components and show a roadmap of how these components will be assembled together to create a fully functional system. The system design divides the system into various modules and shows how the modules interact with each other to create a complete system. Inputs, processes and outputs of each module are identified and assessed on how they are related. The proposed system should meet users' objectives as well as be in line with the vision, mission and core values of the organization. The interfaces of the proposed system should provide ease of use through the use of clearly label labels and commands. The system should be reliable, efficient and also free from errors. The programmers should make sure that they use a programming language that is compatible with recent technologies such as sending text messages, sending emails etc. The system should also be easy to upgrade and maintain.

4.2.1 SYSTEM DESIGN OBJECTIVES

- The interface of the proposed system should have clearly label controls.
- The proposed system should be free from bugs

- The system should be in line with the vision, mission and core values of the organization as well as meeting the requirements of the users.
- The proposed system should be computerized and eliminate all manual processes
- Efficiency –instant output is a prerequisite of the proposed
- flexibility – It should be easy to add new modules or integrate modules on the proposed system
- Security – Authentication, firewall and encryption should be implemented to provide security on the system
- Reports – The system should be able to generate daily, weekly, monthly and annual reports
- Backup – The system should have a backup facility

4.2.1 CONTEXT DIAGRAM OF THE PROPOSED SYSTEM

Shelly and Rosenblatt (2012) define a context diagram as a diagram that shows how the system relates to its externalities as well as showing the boundaries of the system. It shows the system entities as well as the inputs received from the entities by the system and also the output the entities get from the system.

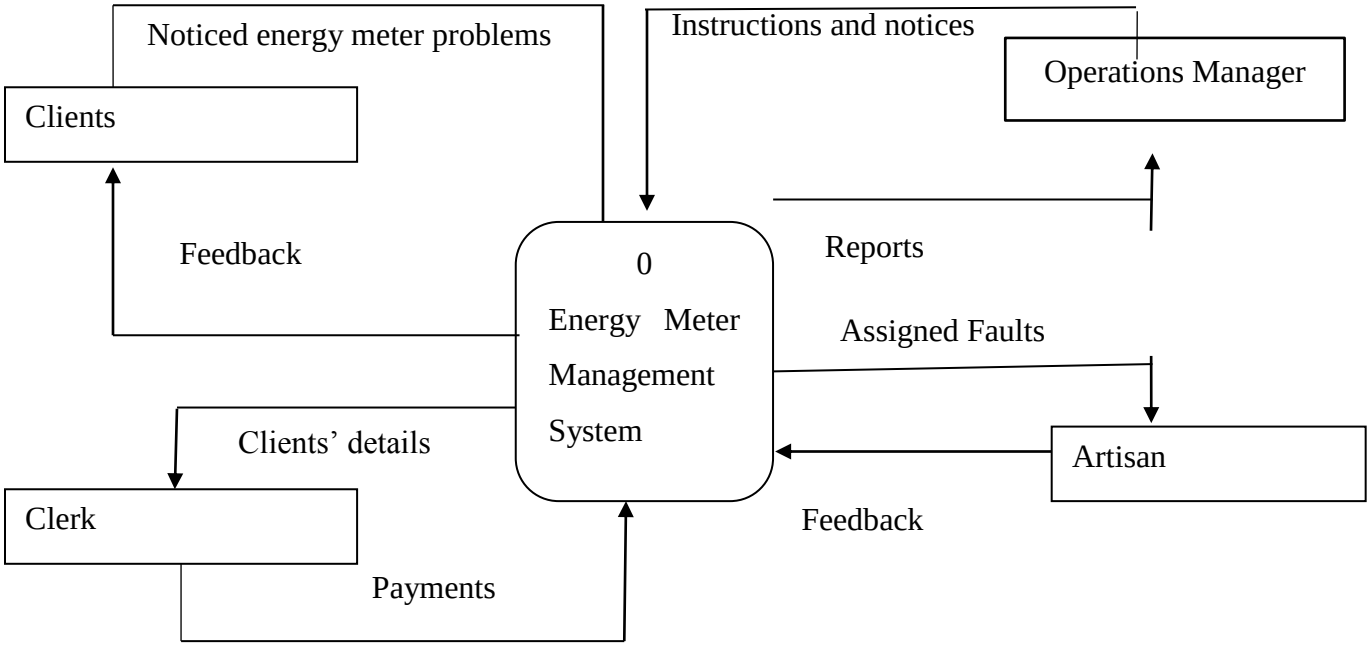


Fig 4.2 Context Diagram for the Proposed System

4.2.2 DATA FLOW DIAGRAM OF THE PROPOSED SYSTEM

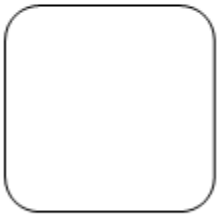
Butt (2014) claims that a data flow diagram shows the major processes of the system in their order of execution up until the final results are accomplished. It also shows various system entities showing the inputs the system receives from these entities and the output of each process and also shows the data stores where system outputs are stored.

.

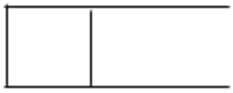
Key for the Contexts diagram and the Dataflow diagrams

Entity

Data flow



Process



Data store

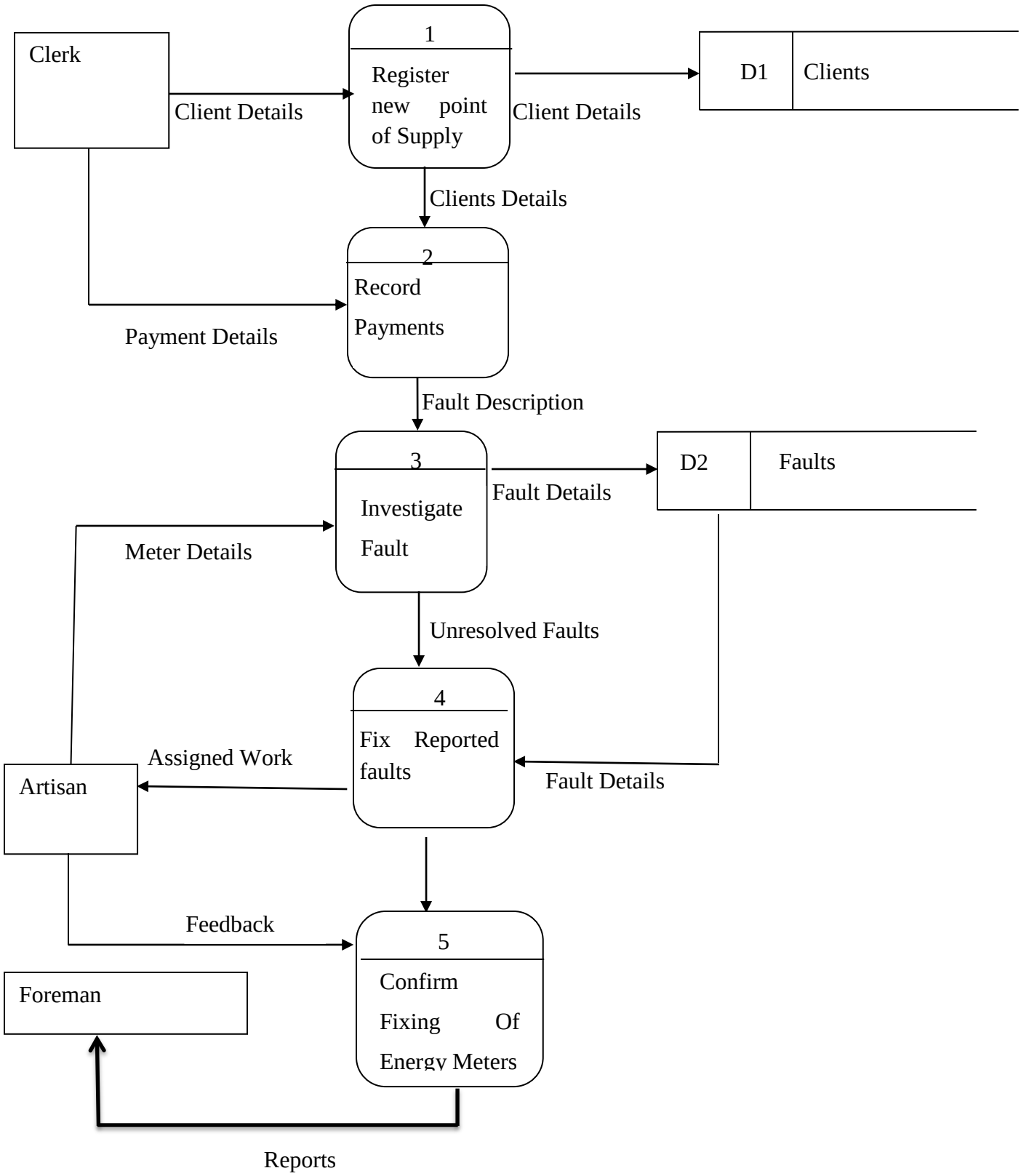


Fig 4.3: Data Flow Diagram of the Proposed

4.3 ARCHITECTURAL DESIGN

Kendall ‘and Kendall (2012) posit that architectural design is a design process that explores how computer networks can be utilized to promote interoperability between software configurations and the hardware to be deployed. It breaks up the hardware and software into components part and explores how these parts relate to each other. Zacker (2012) claims that architectural design is concerned with the system’s format or outlook. It explores how the front end of the system coordinates with the back end. The architecture of the proposed system will consist of:

i) Client Machines/Terminals

Client computers provide the users with the interfaces for entering data into the database as well as the platform for accessing data from the database.

ii) Printers

At least one printer is needed to print reports that may need to be presented to the management in hard copy format.

iii) Database and Server

The system server will have a multisharing relational database on it and MySQL server will best suit for multisharing purposes.

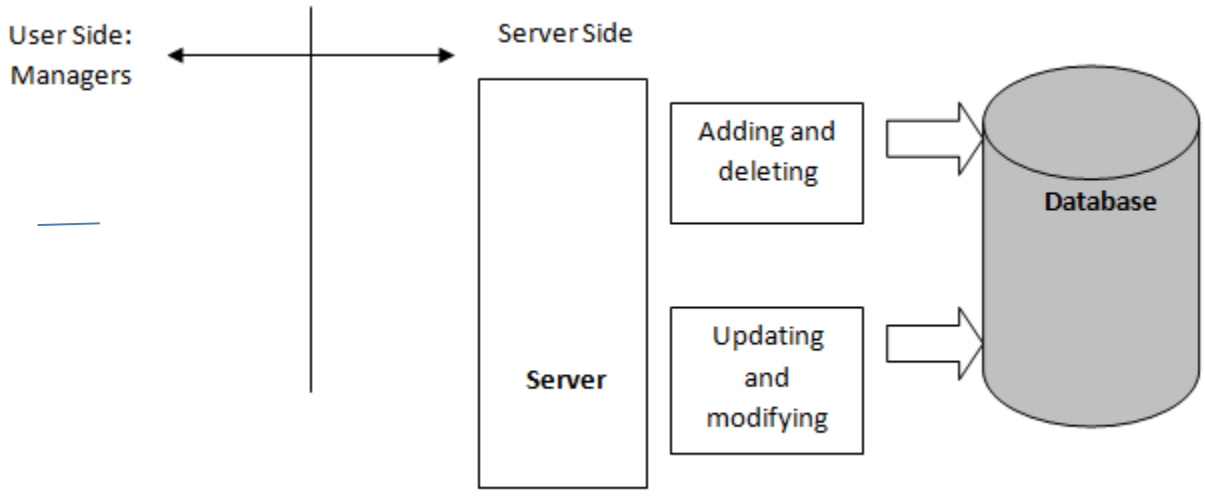


Fig 4.4 Architectural design of the system:

4.3.1 CLIENT SERVER APPROACH

Client-server model can be defined as the network system's disseminated coordination structure amongst system clients, providers, service requestors among others (Jawadekar, 2014). Dennis (2011) further outlined that the connection to the server is established via a network. The central network is also referred to as the computing theory constructing functionality because it facilitates access to database as well as mail altercation. Simple Mail Transfer Protocol (SMTP), Domain Name System (DNS) and Hypertext Transfer Protocol (HTTP) are some of the protocols that are constructed nearby the server model. Client computers throw requests of the processes or the data that is needed from the server because the server is the one that stores the data, controls most of the processes and pass the outputs from various processes to the clients. The internet links the servers and the clients.

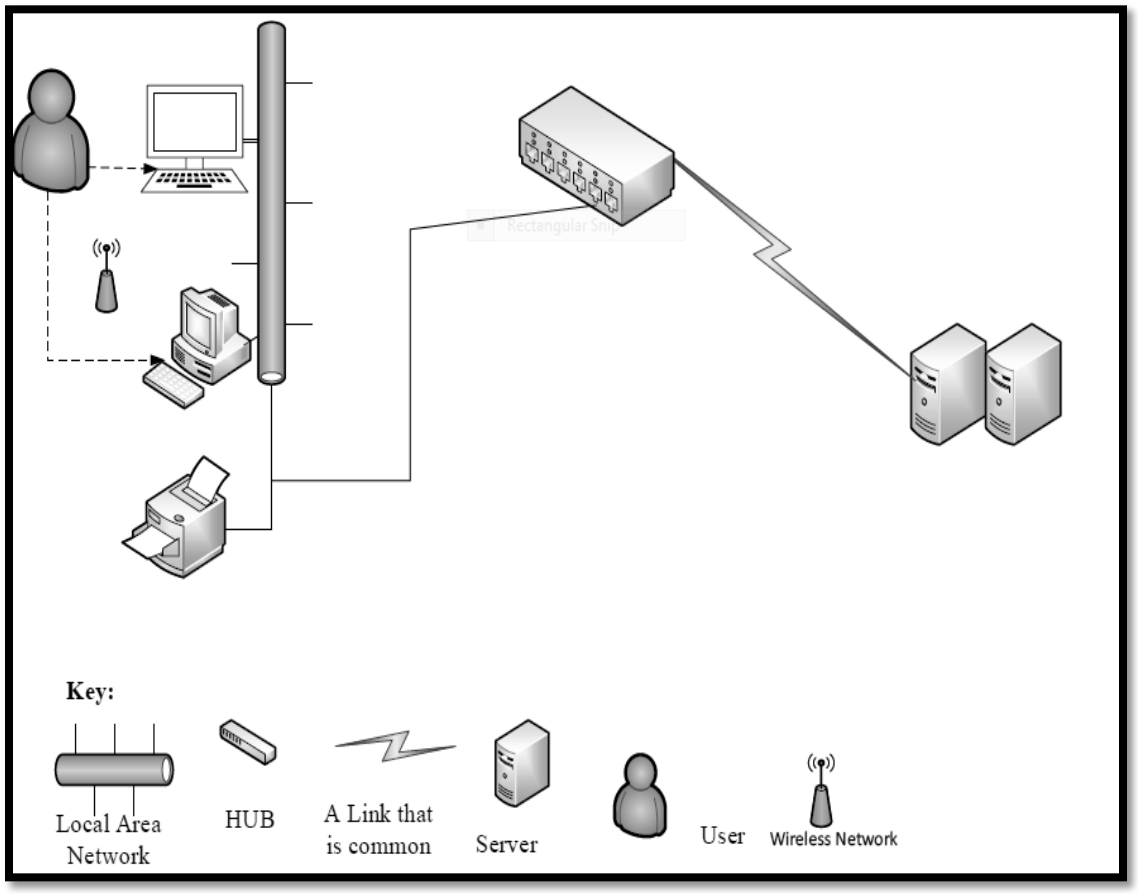


Fig 4.4 Client Server approach

4.3.1.1 ADVANTAGES OF CLIENT SERVER APPROACH

- It is easy to distribute data using MySQL database
- The manipulation of data in the database is easy
- The client server approach facilitates data commonality as well as communication between servers and clients.

4.3.1.2 DISADVANTAGES OF CLIENT SERVER APPROACH

- There may be congestion due to system overload.

4.4 PHYSICAL DESIGN

Shelly and Rosenblatt (2010) assert physical design as design process that logically transforms the concepts into technical design. It involves realizing the depiction of the system's physical database by altering and assembling data throughout the logical designing stage. The physical design covers the system's inputs, processes and outputs and uncovers the relationship of the hardware and software by making connections to the server. A server stores data, monitors and controls system processes.

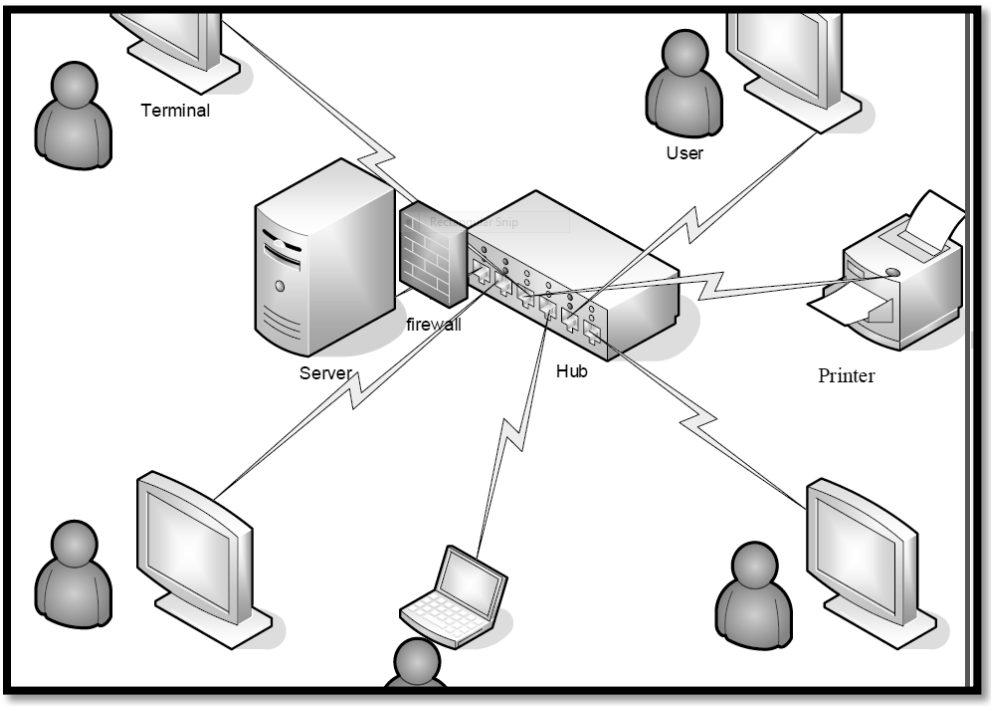


Fig 4.5 The physical design

4.5 DATABASE DESIGN

Cwalina and Abrams (2012) castigated that database design involves data analyses, data designing and examining and arranging the data to support business processes. Cwalina and Abrams (2015) added that prototypes are used to enhance coordination among system developers and system users. All Database tables are normalized to avoid data redundant.

4.5.1 DATABASE ARCHITECTURAL DESIGNS

Database architectural involves arranging data in the database into modules called schemas (Cwalina and Abrams, 2012). The ANSI-SPARC involves three database architectures which are the external level, the internal level and the conceptual level. They facilitate a customised users' view of the database by showing how the database is represented physically.

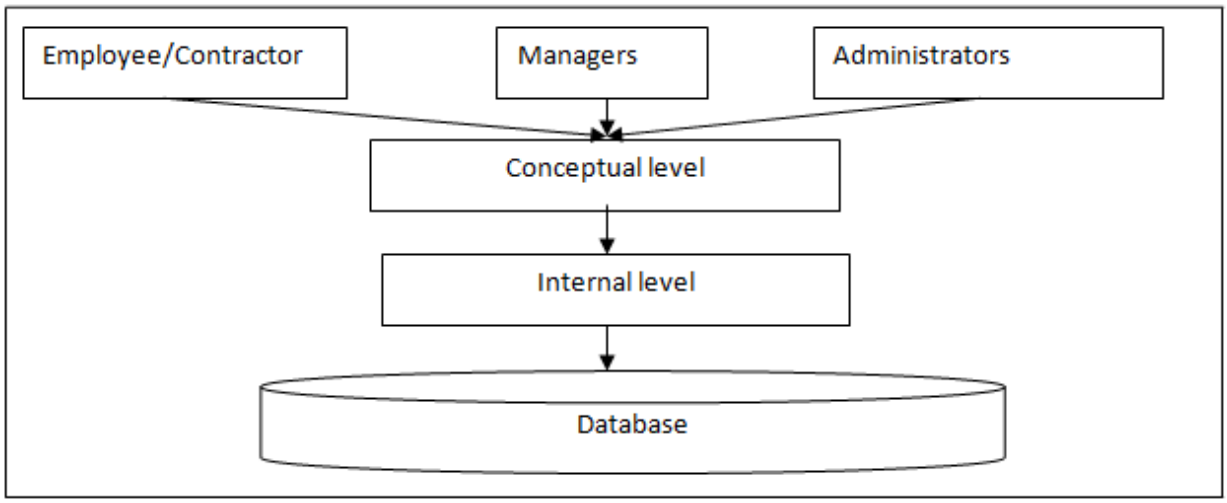


Fig 4.6: Database architecture

4.5.1.1 EXTERNAL LEVELS

The external level signifies how the users interpret the database. Users have different database views and each user match a specific part of the database. Users access the database depending on the access privileges granted to them. For instance customers have a limited access of the database as compared to the system admin. The database administrator has all privileges and also full control of the database than artisans and customers. The system admin have the platform to register, update and delete the details of all users.

4.5.1.2 CONCEPTUAL LEVEL

The community has its own interpretation of the database and this is presented in the conceptual level. The conceptual level involves data identification and examination as well as the relationships between data. It also includes the coordination between departments as well as how resources are allocated to each department. It also encompasses system validation and how the users are authorized. Authorizations will be granted to the users through the use of usernames and passwords. Access into the system is denied if the visitor is not registered in the system.

4.5.1.3 INTERNAL LEVEL

The internal level shows how the database stores data by taking into account file organization and data structures. It is also more concerned about how data is encrypted and compressed, procedures, allocation of storage space, indexing as well as how the database beholds the records.

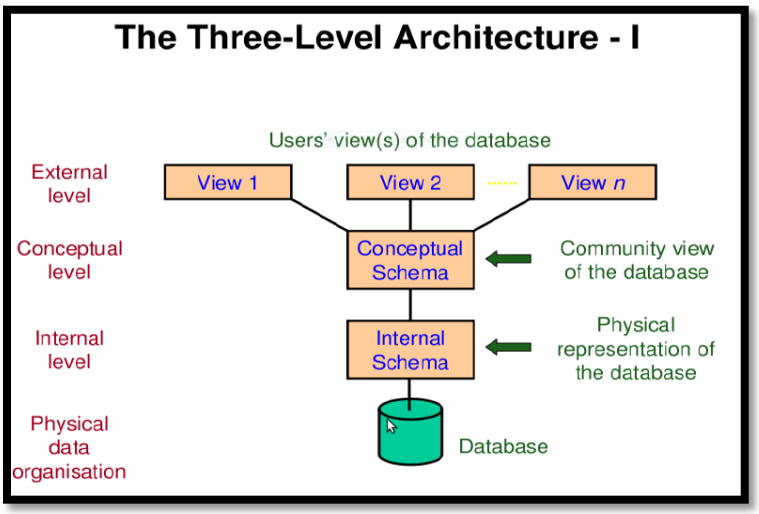


Fig 4.7: Database Design

4.5.2 LOGICAL DESIGN

Dennis (2013) castigated that the relationship of the system entities are reflected by the logical design. Attributes are sub elements of entities. Entities have relationships with each other as well as attributes. Attributes are used to differentiate entities as well as to identify them. Primary Keys are also used to identify entities.

4.5.2.1 TABLE FOR PROPOSED SYSTEM

Tables are basic part of data structures. Tables have columns as well as rows which are also referred to as tuples.

4.5.2.1.1 USERS DETAILS

Table 4.1 Login Table

FIELDS NAME	DATA TYPE	DESCRIPTION
Id	Integer	Auto Increment
Name	Varchar(100)	Name of the user
Surname	Varchar(100)	Surname of the user
Username	Varchar(30)	Username used for login
Password	Varchar(15)	Not less than 8 characters
Access	int(3)	Determine privileges

TABLE 4.1 CUSTOMER TABLE

FIELDS NAME	DATA TYPE	DESCRIPTION
Customer_Name	Text	Customer's name
Customer_Surname	Text	Customer's surname
Gender	Varchar(6)	Whether male or female
ID_Number	Varchar(15)	Customer ID Number
Address	Varchar(50)	Customers Physical Address
Contact	Varchar(30)	Customers Contact Details

ACCOUNTS TABLES

FIELDS NAME	DATA TYPE	DESCRIPTION
Account Number	Text	Primary key
Customer ID	Text	Customer's ID
Balance	Double	Account Balance

FAULTS TABLE

FIELDS NAME	DATA TYPE	DESCRIPTION
Account Number	Text	Primary key
Customer ID	Text	Customer's ID
Fault	Varchar(100)	Account Balance
Remarks	Varchar(100)	Any other fault details
Date Reported	Date	Date fault was reported
Date Solved	Date	Date fault was solved

4.5.2.2 ENHANCED ENTITY RELATIONSHIP DIAGRAM

Gupta (2012) postulates an Enhanced Entity Relationship Diagram (ERR) as a diagram that highlights different data structures that are found within the system as well as the flow of data. According to Vladmar (2013), an enhanced entity relationship can be simply defined as a diagrammatic representation of the relationships that exist amongst entities in a computerized framework. It is an abstract view of the actual system.

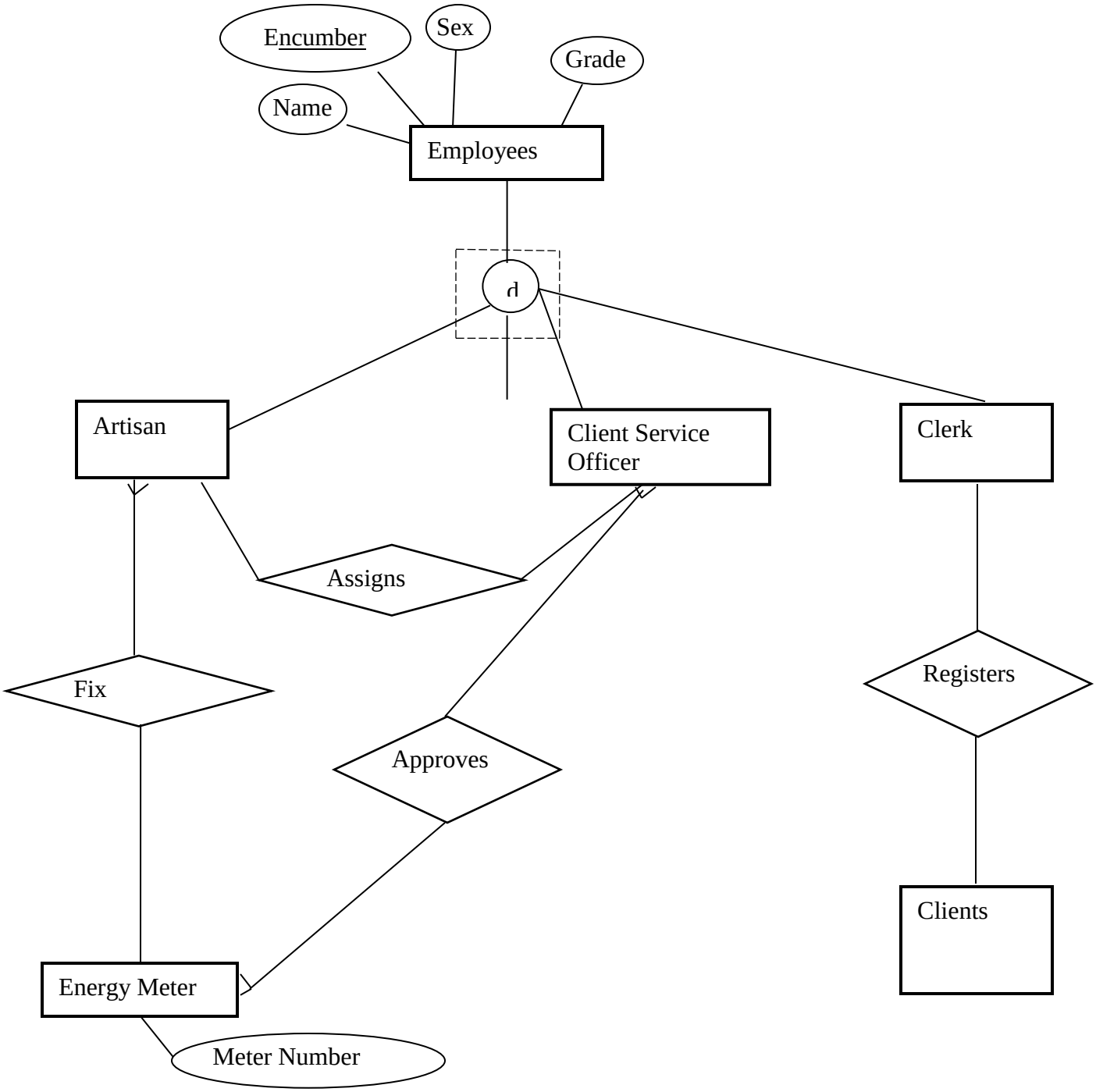
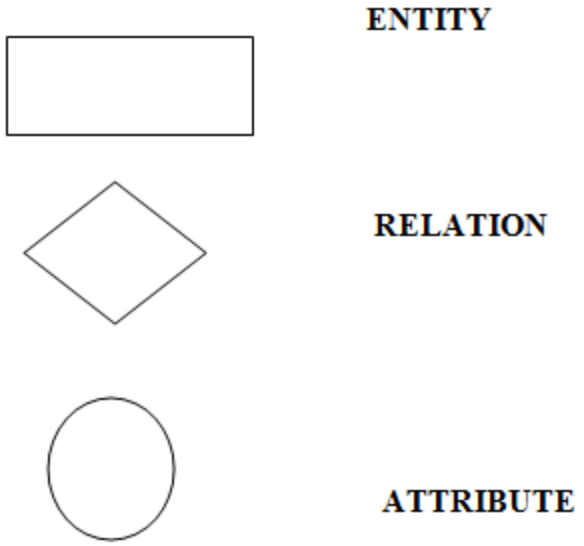


Fig 4.8 Enhanced Entity relationship for the proposed system

Key



4.6: PROGRAM DESIGN

The design phase encompasses the generation of blocks of codes that integrates the forms designed during interface design and the source code to come up with a system that can execute tasks as required (Kendall, 2012). Authorization and authentication aspects of the system are specified on the program design section. Authentication is a process which confirms whether the supplied login credential combination match those in the database.

4.6.1 PACKAGE DIAGRAM

Methal (2013) defined a package diagram as a diagram that have its components derived from a class diagram and shows the elements of the system and their interdependencies.

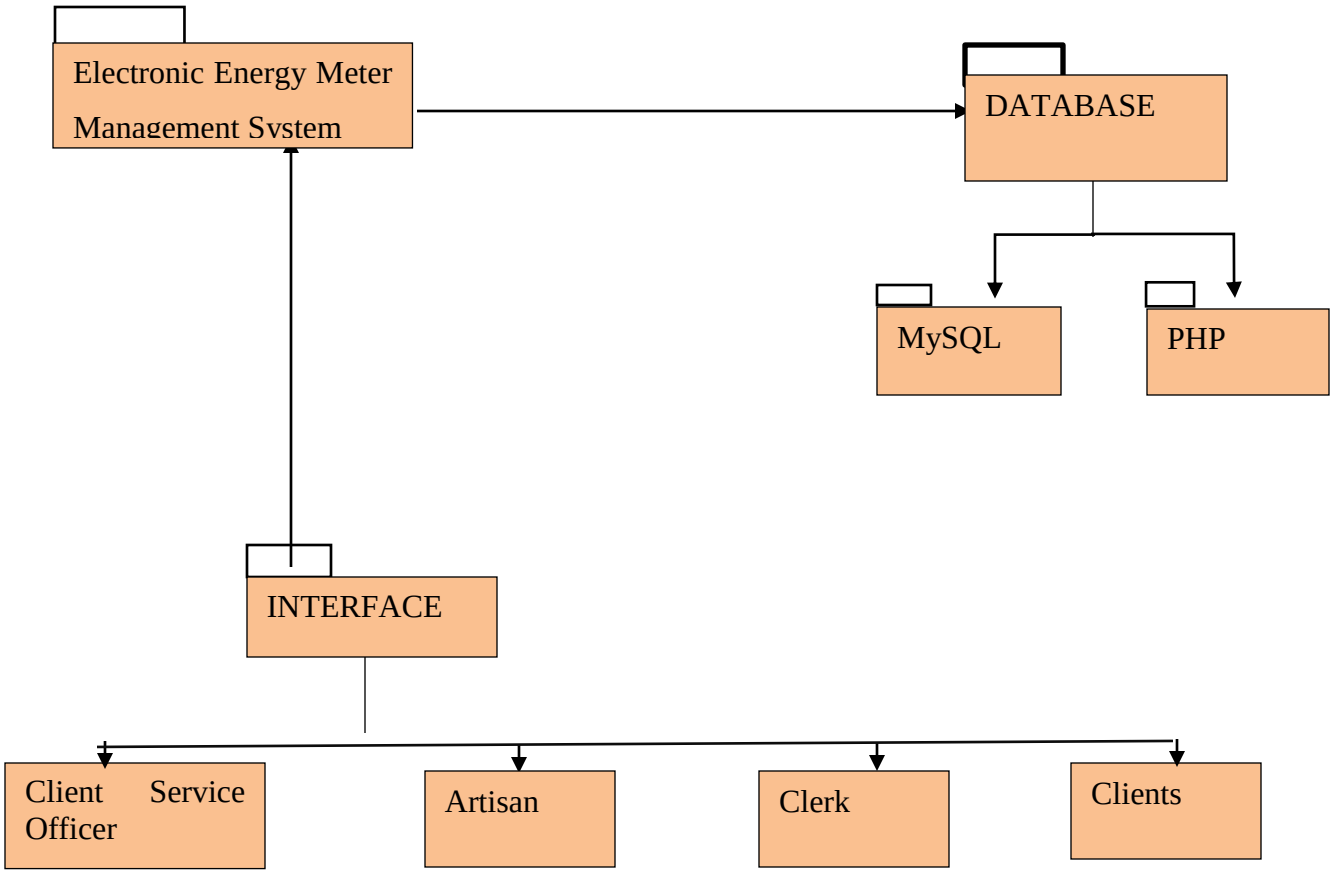


Fig 4.9 Package Diagram

4.6.2 CLASS DIAGRAM

Dennis (2013) postulates that a class diagram describes the features of the proposed system without exploring different processes the system has to offer. Kendall (2012) added that a class diagrams highlights the relationships between classes and entities.

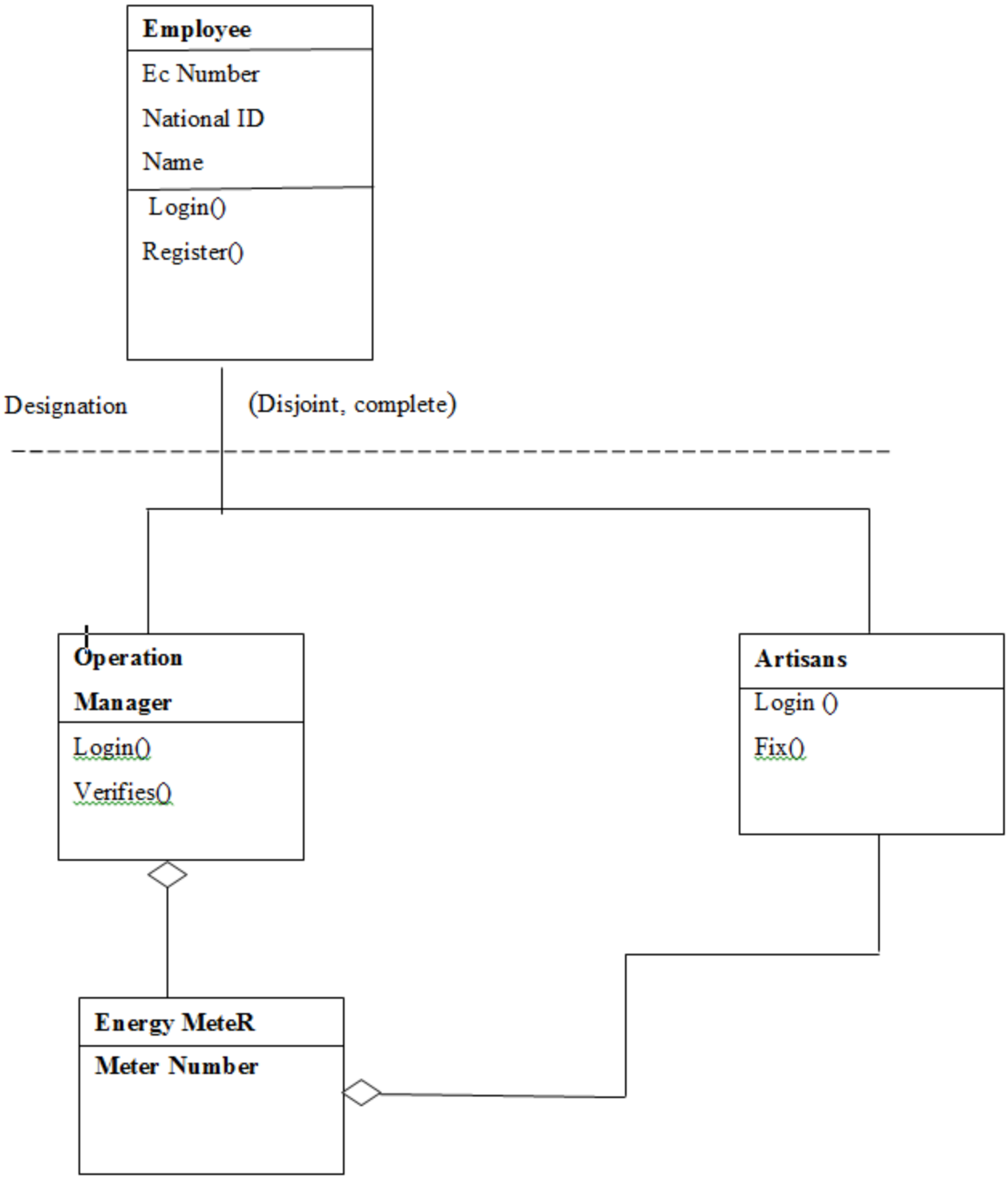


Fig 4.10 Class Diagram

4.7 INTERFACE DESIGNS

The interfaces to be used on the proposed system should have clearly labelled controls and the use of bright colors should be avoided whenever possible.

4.7.1 MENU DESIGN

Lowery (2012) postulates that menu designing shows how the proposed system will capture data. The interface will be a graphical user interface so that system users will find it easy to use the system.

4.7.1 MENU DESIGN

The home page will contain the main menu which consists of login, about us and contact us link.

HOME	LOGIN	ABOUT US	CONTACT US

Fig 4.9 Menu Design

4.7.1.1 MAIN MENU

The system user is welcomed by the home page after visiting the company's website. Every user is welcomed with the main menu after he or she log in. The administrator's menu consist options for adding, modifying and deleting new users.

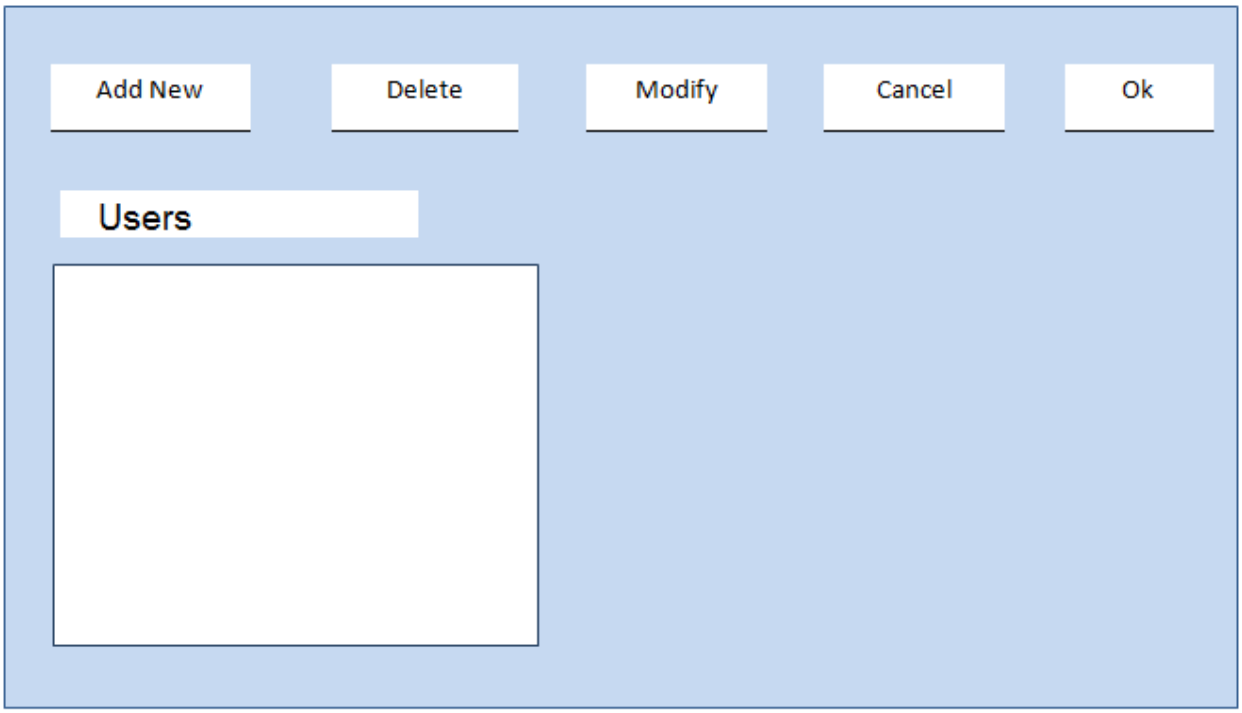


Fig 4.10 Main Menu

Fig 4.10 Main Menu

4.7.1.2 SUB MENUS

Submenus provide the admin with more options after he selects an option from the main menu. Links for inserting, updating and deleting data are usually located on submenus.

4.7.2 INPUT DESIGN

Somerville (2011) outlines that input design transform the depiction of the system into a programmer-oriented requirement. Input design outlines field length, data format and data length (Lowery, 2002).

4.6.1.3 USERS LOGIN FORM

The admin needs to provide correct log details to access the system. An error message pops up if the admin supply incorrect credentials.

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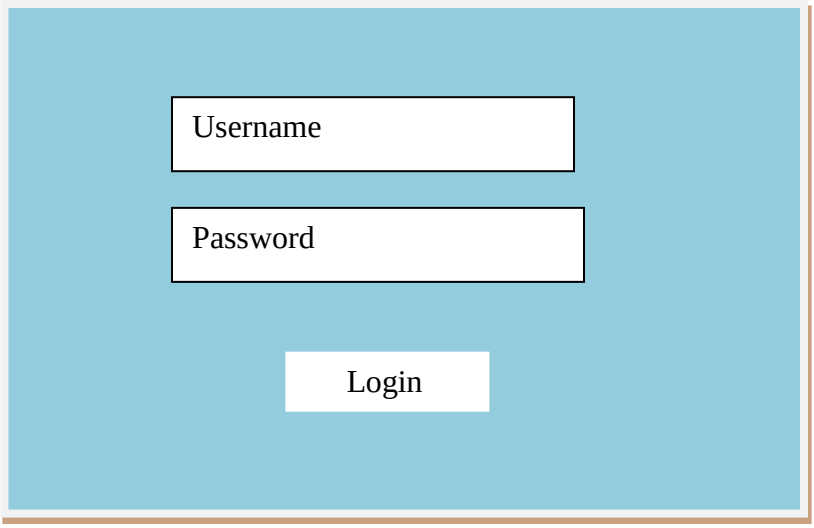


Fig 4.12: Users Login

4.6.1.10 OUTPUT DESIGN

Shelly and Rosenblatt (2010) define output design as a sketch demonstration, in black and white, of how the system output will be presented by the system. The output design needs to show the controls such as tables, labels and textboxes.

4.6.1.11 GADGET FAULT DETAILS

Fig 4.19 below shows how reported faults will be presented in the system

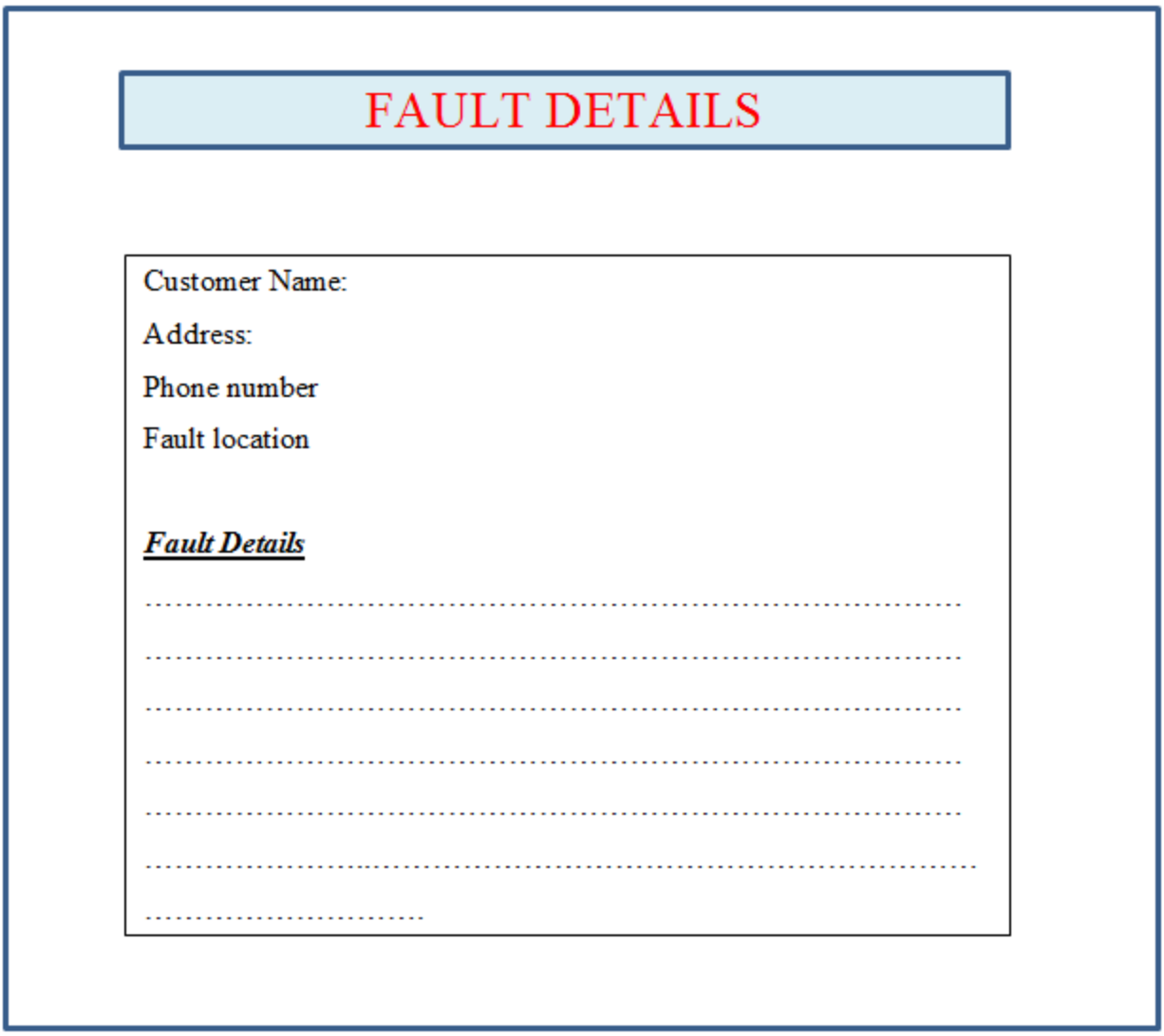


Fig 4.19 Gadget Fault

4.8 PSEUDO CODES

Pseudo code is a description that explains computer algorithms written in natural language (Drury, 2010). Pseudo codes are independent of all programming languages and can be understood with any person with little or no programming background. Pseudo codes are usually written during system development and the programmers will then convert pseudo codes into actual programming code using any language of their choice.

Add Users

Visit the system

Access the login form

Login

Access the user's panel

Enter user's details

Check for validation

If validation process pass

  Save user details

Else

  Pop up an error message

Logging into the System

Visit the system

Click on the **Login** Link

Enter login credentials

If credentials are correct

    Access your account

Else

    Pop up a login error message

Report Fault

Visit the system

Provide authentication details and enter into the system

Visit the faults panel

Enter a description of the fault

Send Details

Assigning Faults

Log in as the supervisor

Visits the new faults panel

Select a fault

Assign the artisans with faults for them to fix

4.9 SECURITY DESIGN

Security design is employing various security techniques and methods on the system to avoid unauthorized access and misuse (Dumber, 2013).

4.9.1 PHYSICAL SECURITY

Dumber (2013) claims that physical security is a form of security imposed on information systems which denotes providing shields to offices to avoid unauthorised access to organisational assets and data. This is done to avoid terrorist attacks, vandalism and theft. CCTVs, security guards, locks, fencing, biometric access control systems, surveillance cameras and notification systems, such as smoke detectors, heat sensors and intrusion detection sensors can be used to physically secure the systems.

4.9.2 NETWORK SECURITY

Kendall (2015) defined network security as safeguarding computer networks and all network traffic to avoid unauthorised network access. Every information system should have a system administrator who gives the users access levels for them to access the network. Viruses do affect computers as well as networks so the system administrator should make sure that the servers and all client computers have up to date antiviruses installed on them. Each network should have a distinct name as well as a distinct password. The password should be encrypted and changed periodically.

4.9.3 OPERATIONAL SECURITY

Dumber (2013) defines operational security as a security measure imposed on information systems which involves safeguarding information which is regarded as crucial and confidential to the organisation. It involves making sure that all the business operations and processes are secured from network breaches. Operational security can be ensured through encrypting emails to avoid electronic eavesdropping and counter spoofing. Current encryption methods which are

more secure should be employed on all emails. This will ensure competitive advantage to the organisation.

4.10 CONCLUSION

This chapter has shown the content and data flow diagram in order to explore the entities as well as the processes to be involved in executing the proposed system. The architectural design has shown that the proposed system will have client computers, printers and the database server. MySQL server database is going to be used as the system backend because it is fast, robust and allows multi user access. The enhanced entity relationship diagram has shown that the entities of the proposed system are employees, artisans, clerks, energy meters and clients. Network, physical and operational security should be imposed on the system to avoid intruders from getting access into the system. The next chapter highlights the processes that were involved in developing the proposed system.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 INTRODUCTION

After developing the system, there is need to implement the system so that the users get can start using it. This process of implementing the system should only be done after making sure that the system is fully complete and error free. The system should be thoroughly tested to make sure it is free from bugs. All the fields on the forms should be validated and this is crucial in making sure that the system only capture data which is in the right format. Verification is also important in making sure that the system provides the required functionality. The system should also be compatible with the available hardware for interoperability purposes. All users of the system should be provided with adequate training so that they can fully utilize the system. The system should meet all the objectives specified by the system users. The system should have adequate security measures to avoid hacking.

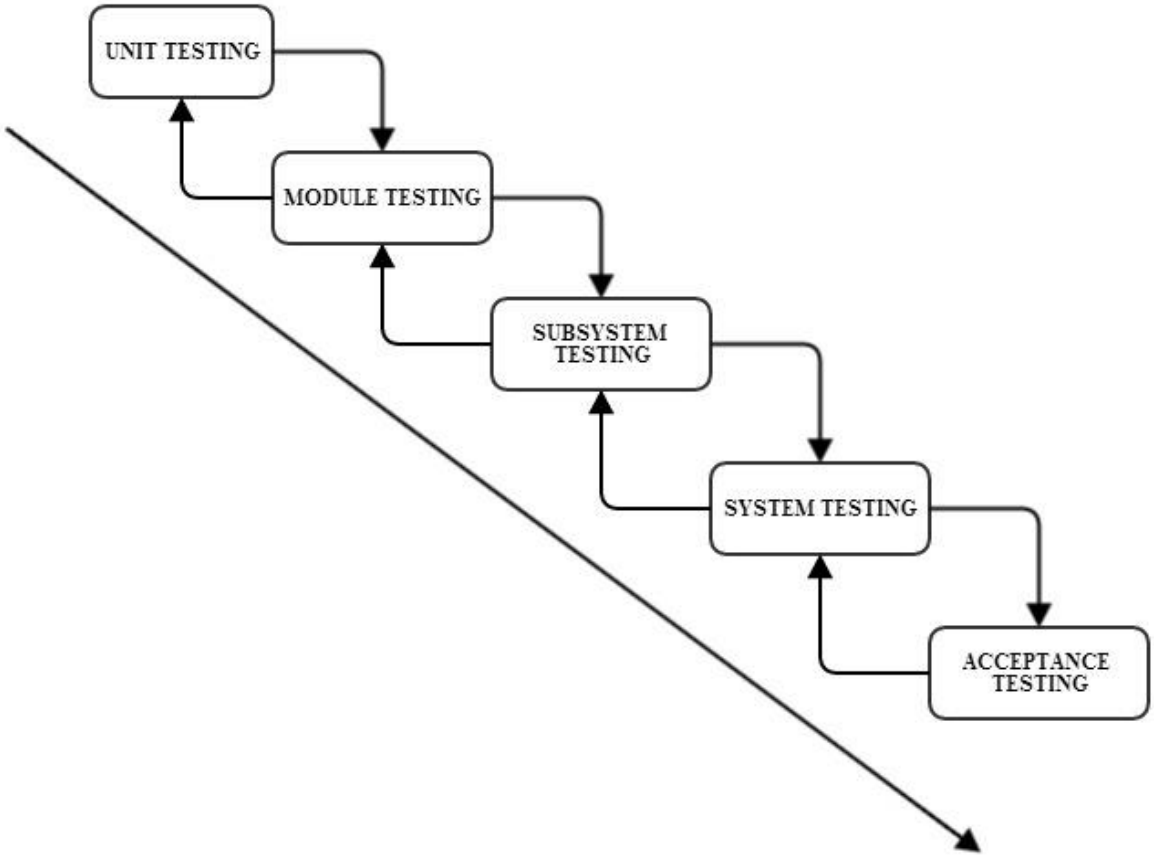
5.2 CODING

Hoffer et al (2017) define coding as a process of writing instructions that are to be read by a compiler in order to provide the required functionality. Coding is the major important part of the development process and it involves physically creating the system. The programmers choose the best programming language depending on the nature of the program to be developed. The application may either be a desktop, web or mobile application. Programming languages such as C#, Visual Basic .Net and java can be used to develop desktop applications. PHP, ASP and JSP can be used to develop web applications. Mobile applications will require android programming language. The system was developed using HTML, CSS, PHP and JavaScript. MySQL database was used as a backend.

5.3 TESTING

Gupta (2012) defines system testing as a process whereby system users get access to the newly developed system to verify it the system provides the required functionality and check for errors. The users should tests different parts and modules of the system including unit testing, module testing and testing the whole system. Validation and verification should be tested on the newly developed system. All the errors that were identified were fixed right on the sport and all the

testing phases were successful. The testing phase gave the users assurance that the system will be of benefit to them. They were merely satisfied with the functionality provided by the system. Fig 5.1 below shows stages that were followed by the developer in developing the Energy Meter Management of the system.



Source: Perry (1983: 208)

Figure 5.1: Testing stages

5.3.1 UNIT TESTING

Bently (2011) defines unit testing as an error identification process whereby the users test a specific section on the system. The first test carried out was to verify if the system successfully connect to the database server. No connection error was identified. The login section was tested for authentication and it was found that the system could not be used without passing through the

login form. Sessions were used to make sure that any user who tries to bypass the login process is directed to the login form.

5.3.2 MODULE TESTING

Jawadekar (2014) postulates that module testing is a system testing strategy that combines two or more system units so that they are tested together to verify if they can operate together as well as to find the degree of dependency between them. Module testing can also be referred to as integration testing. Assembling various units of the system will result in the creation of system modules. All the system units that were integrated were tested for functionality and all the errors that were discovered during testing were instantly resolved. The section for registering new clients was integrated with the section for making payments. It was discovered that once a client has been registered he/she can be able to make payments. All the remaining units were added to those that were tested until all of them get tested.

5.3.4 SYSTEM TESTING

Jawadekar (2014) posits that system testing is the testing strategy which involves combining all the modules of the system to make a complete system which will then be tested as a whole. It is crucial to take not of the performance of the whole system and all the errors that may have arisen during integrating various system modules should be resolved. The objective of system testing is to verify whether using the newly developed system will enable efficient execution of business processes or not. It must be reviewed whether the new system performs better than the old system or not. The developed system should be fed with more data so as to ascertain whether the performance of the system will be affected or not. The output of the data should also be reviewed taking into consideration how the data is presented to the users. The analyst used two methods to test the system which are white box and black box testing.

5.3.4.1 BLACK BOX TESTING

Tannenbaum (2010) defines black box testing as a system testing strategy whereby the analysts are much concerned with the output obtained from the system measured against the system inputs. Mockler (2011) made it clear that black box testing tests the system whether it is able to provide the intended functionality stipulated in the system objectives and in the functional

requirements. More data is fed into the system noticing the processing of data and how quickly it will be presented to the users. The presentation of data is also taken into account which considers display tables and graphs. Module interoperability is also tested after all the system modules have been assembled together. The system is also fed with abnormal numbers, negative numbers as well as decimal numbers to verify how it will handle calculations using these figures. All the users' system objectives were tested to verify if they were being met by the newly developed system.

5.3.4.2 WHITE BOX TESTING

Mockler (2011) posits that white box testing is a system testing strategy whereby the analyst tests the source code of the system for errors without taking system objectives into consideration. Butt (2014) pointed out that white box testing can unveil source code errors that were not ascertained by the developer on the time of developing the system. Such errors include logic errors, such as infinity loops, and runtime errors, which can arise after dividing numbers by zero. The source code of the system should be modularized through the use of functions and classes so as to shorten the code and make it easy to debug.

5.3.5 ACCEPTANCE TESTING

Rankl et al (2013) asset that the last phase in testing the newly developed system is acceptance testing. This testing stage involves identifying whether the newly developed system satisfy the needs of the users. There are cases where the users of the system may deny using the system if they are not satisfied by the functionality or by its interface. Acceptance testing is carried out before installing the system on the hardware where the users can use it. The newly developed system was given to all its users for them to get a grasp of its functionality. The users were amazed by the functionality of the system and pointed out that the functionality was above standard and also beyond what they expected. The users had also been given time to test for security and they were satisfied as they could not bypass the login process. Alpha and Beta testing were also employed to test for user acceptance.

5.3.5.1 ALPHA TESTING

Jawadekar (2014) defined alpha testing as a process of testing for user acceptance through giving users a chance to test the system for errors. The analyst had given the users a chance to test the system and have provided solutions to all the errors that were discovered by the users before installing the system for final use. The system passed this stage and beta testing was also used to test it.

5.3.5.2 BETA TESTING

Jawadekar (2014) defines beta testing as a process of testing for user acceptance through making use of real data inputted by the users. This is done to find out if there are any missing functionality during system development process. Therefore all the functionality on the system is tested.

5.3.6 TESTING STRATEGIES

Various testing strategies were implemented to verify any missing errors on the system. Database connectivity was tested and it was discovered that all the pages were able to interact with the database. All users were able to login and access different accounts based on access levels. Validation and verification were some of the strategies used to test the system.

5.3.6.1 VALIDATION

Mockler (2011) asserts that validation entail testing whether the data that is to be inserted into the database is formatted in the right way. If the data is in the right format, it is stored in the database but when not, an appropriate notice should pop up prompting the user to insert valid input. Validation was tested on various pages which included the page for registering new clients, payments page, add new users page and assign artisans page. All the pages were validated and were only accepting data provided in the right format. Red warning text was used to warn the user in case he / she supplied invalid data.

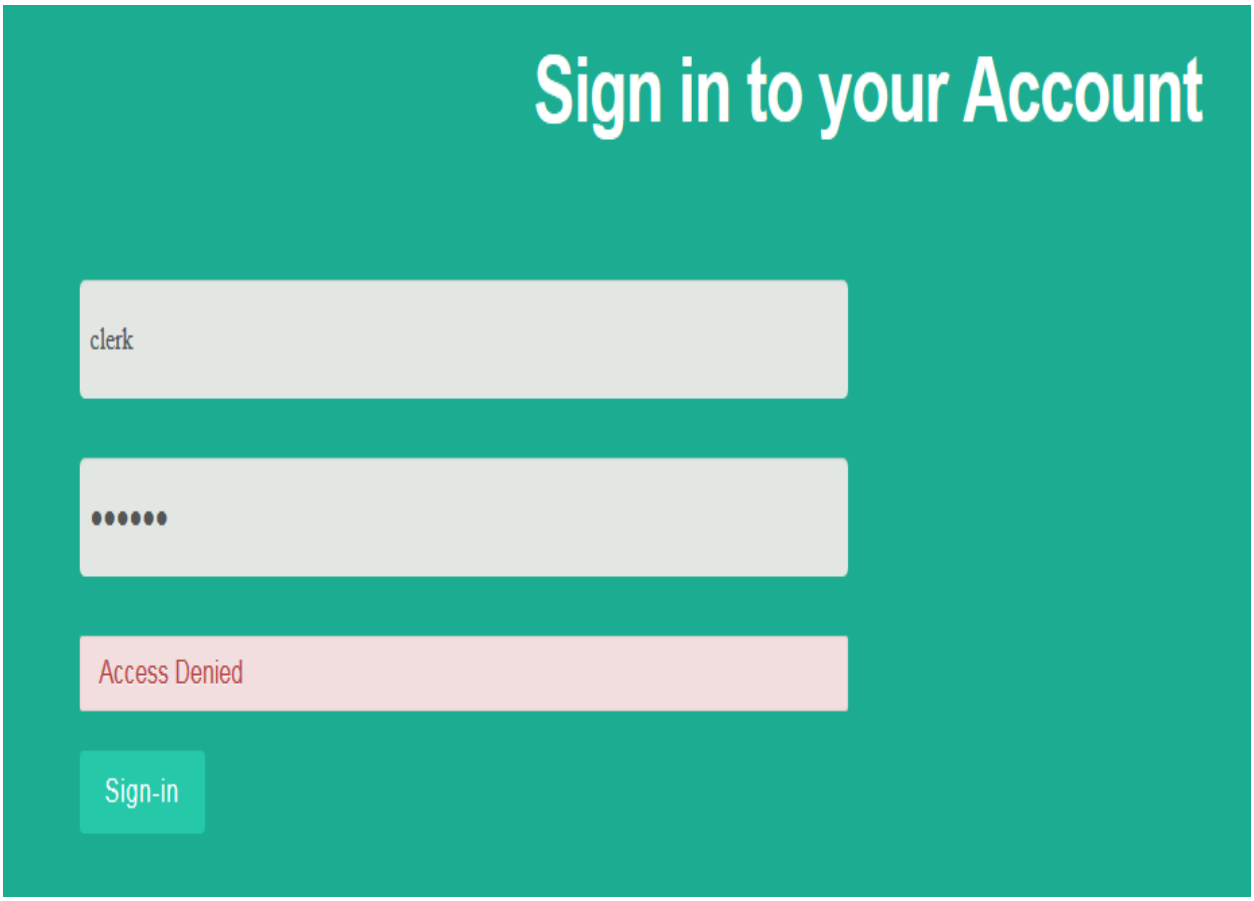


Figure 5.2: User Login Form Validation

The login form is compulsory to all users as it provides security through authenticating all users of the system. Users are required to supply username and password that matches the ones already captured in the database. If a match is found, the user will be directed into the system but when a match is not found, the user will get a pop up message prompting him / her to enter the correct username password combination. The login form uses access levels to direct users to different system platforms.

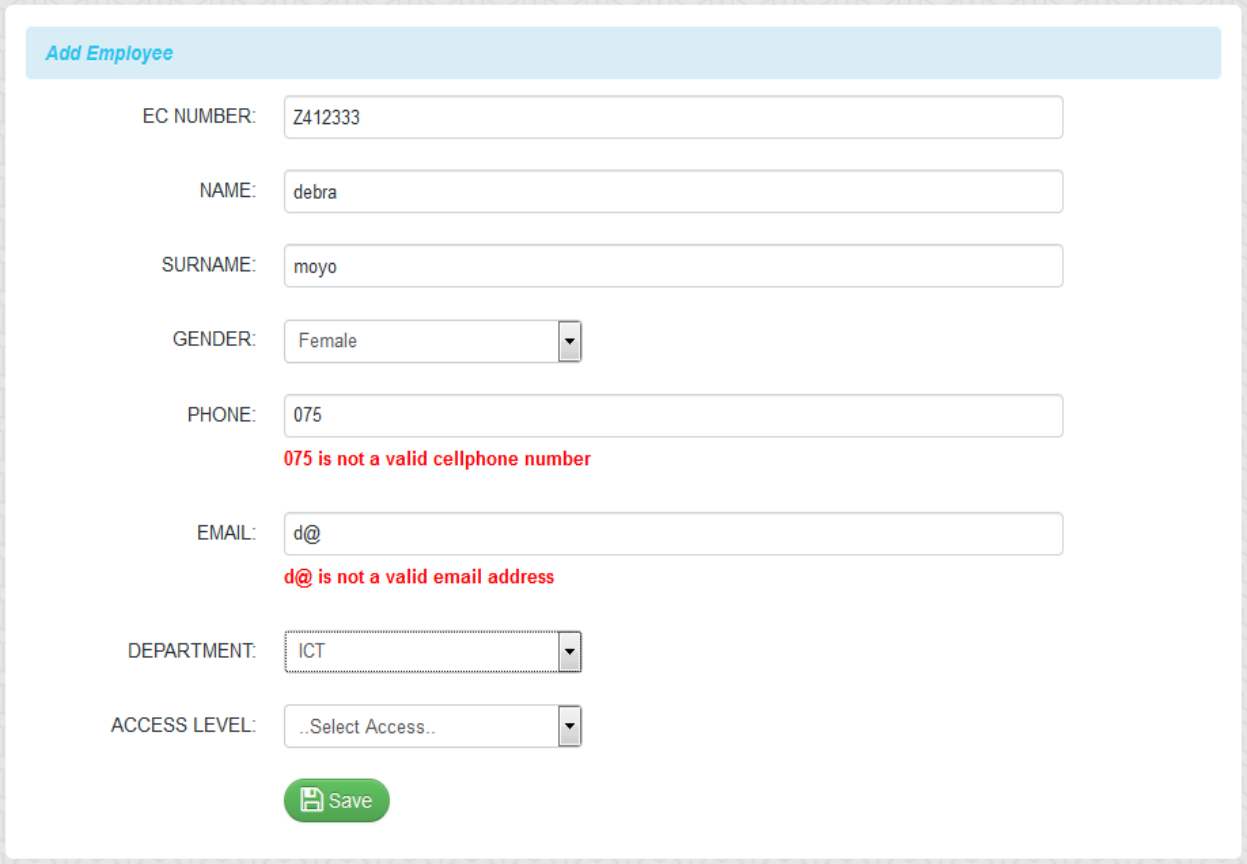


Figure 5.3: User Registration Validation

The admin is the only user who has the platform to add new users into the system. The admin can also retrieve, update and delete users. If the admin click the add user button he will be directed to the add user form illustrated in Figure 5.3. The admin is required to enter a valid phone number with 10 digits (including 0, but excluding country code) as well as enter a valid email address. If invalid data is provided the add user form will pop up error messages as illustrated in Figure 5.3.

5.3.6.2 VERIFICATION

Vermillion (2014) posits that verification compares the system objectives with the functionality that the system is providing. The two must tally for system users to accept using the system. The system developer is questionable in case some objectives are found unsatisfied. The system is valued depending with the degree it meets users objectives. The newly developed system was tested and it met all the intended objectives.

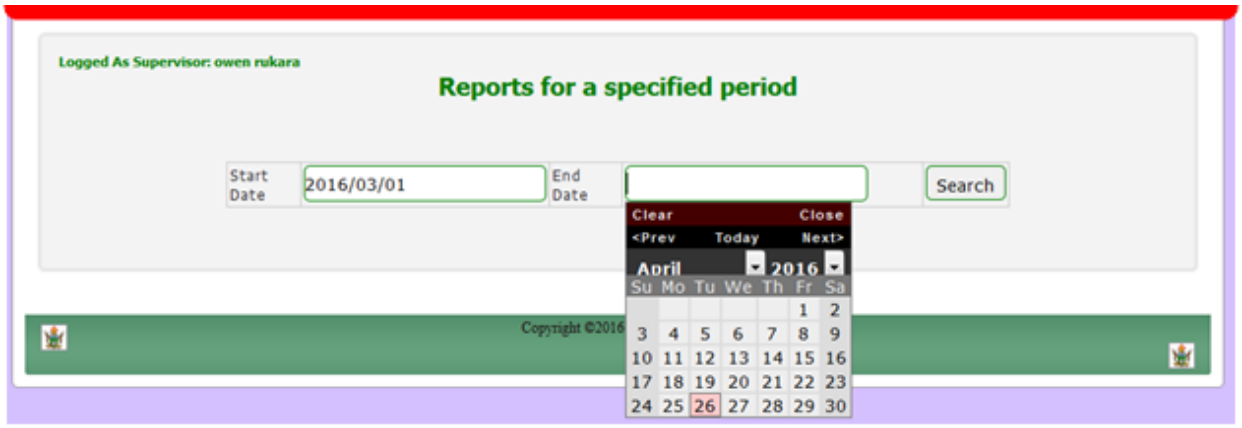


Figure 5.4: Search form

The system provides periodic reports of the faults resolved and the number of meter numbers tempered with. The supervisor should provide the start and end date for the period under consideration.

5.3.6.3 SYSTEM OBJECTIVES VS SOLUTION

Objectives are desired end results or targets that the system seeks to achieve (Jewell, 2004).The proposed system objectives were met as displayed on the following figures.

5.3.6.3.1 Objective 1

Manage client standard family consumption of energy on monthly basis and generate a report to be worked on by users of the system (ZETDC).

Solution (a)

Providing the platform which shows all meters where there is extreme underusage and extreme overusage of electricity.

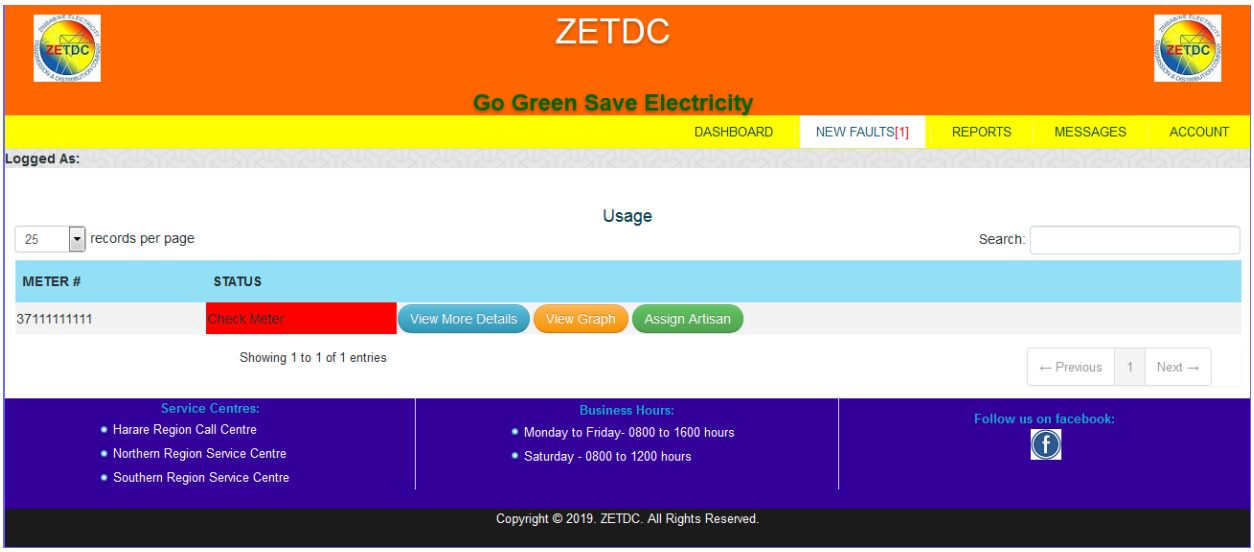


Fig 5.12: Screen shot for objective 1

5.3.6.3.2 Objective 2

To meet customer demand and perform data mining on historical information activities

Solution (b)

Providing a platform to view customers' payment history.

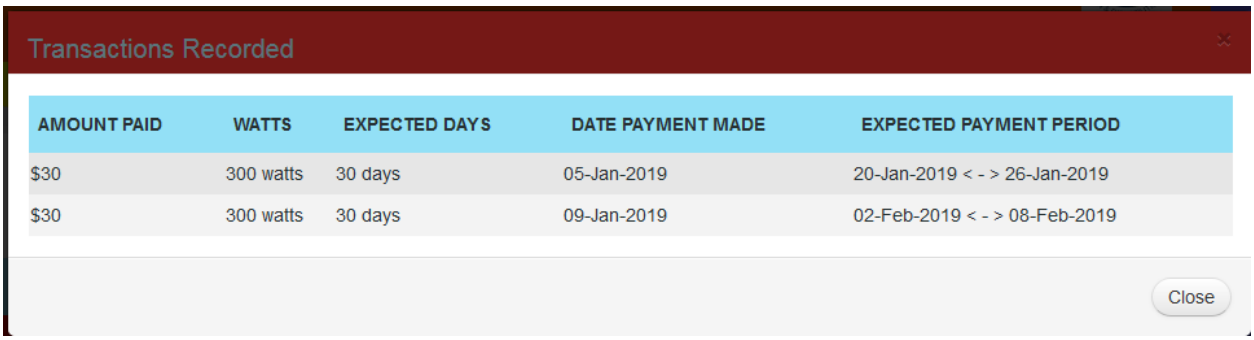


Fig 5.13: Screen shot for objective 2

5.3.6.3.3 Objective 3

To come up with a security support system that locates non- performing metering points through the analysis of patterns with reference to standardized or trending consumption.

Solution (c)

Providing a graph showing usage patterns of customers

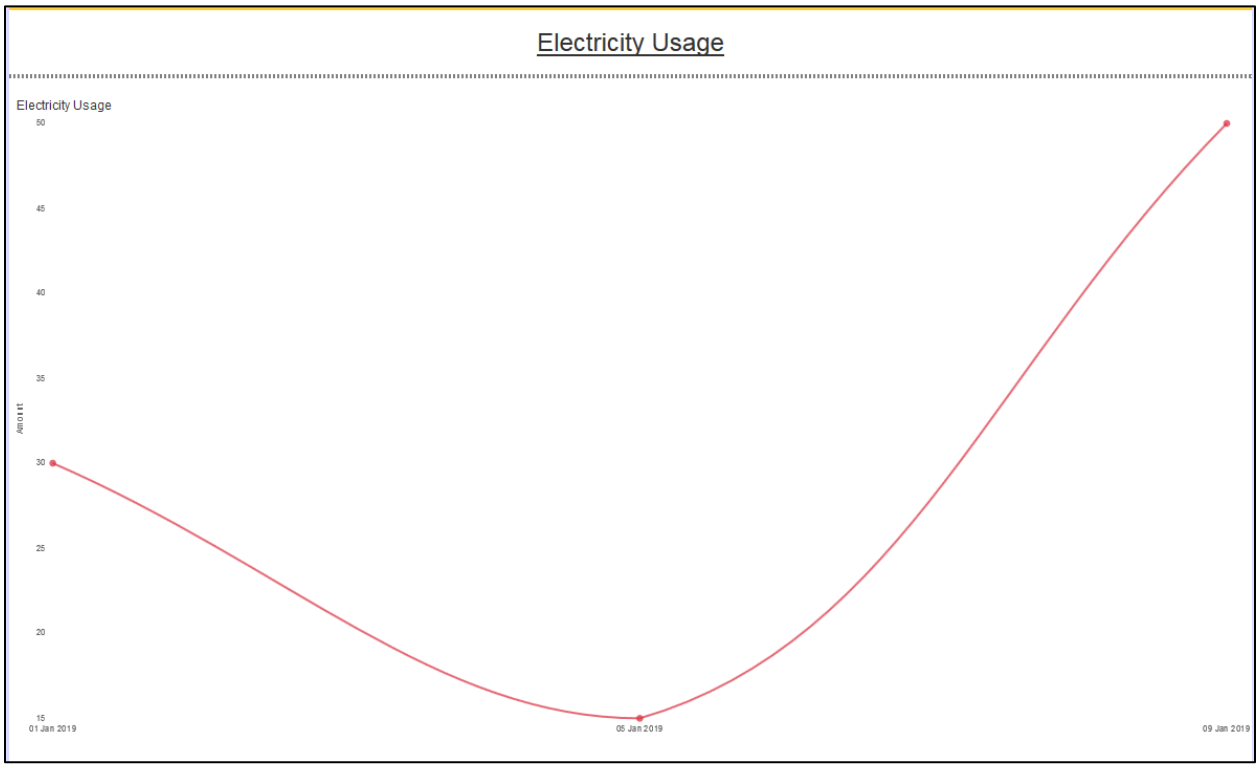


Fig 5.14: Screen shot for objective 3

5.3.6.3.4 Objective 4

To facilitate monthly monitoring of power consumption by customers for assessment and usage tracking

Solution (d)

Providing a platform to view all meters who are assumed to have faults or to have been tempered with

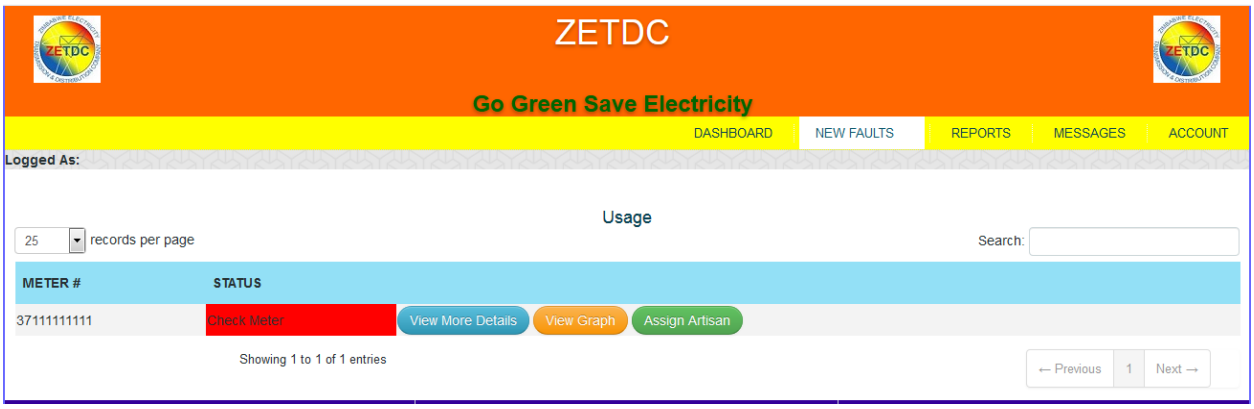


Fig 5.15: Screen shot for objective 3

5.3.6.3.5 Objective 5

To enable ZETDC management make quick decision from the presented information

Solution (e)

Providing the platform to report if the meter is working normal or has been tempered with; if the meter has been tempered with, a police report will be made.

Fig 5.17: Screen shot for objective 5

5.4 INSTALLATION

Roger (2013) posits that installation is a process of deploying the developed system to the hardware it will operate on. This process is only done after the developer meet consensus with

the users that the developed system meets the objectives and it is error free. It is up to the users to replace the old system or to let the old and new system work side by side. The analyst has finally installed the system on all the computers that would be used by the system users. The analyst made sure that these computers had antivirus and web browser installed on them. MySQL database server software was installed on the server machine. Wi-Fi was also set up and all the machines were able to access the system.

5.4.1 USER TRAINING

Roger (2013) assets that training should be offered to system users for them to have adequate knowledge on how they can efficiently use the system. All the system users should be familiarized with the system processes, interfaces and commands. The analysts have provided training to the users in groups. Users with the same access level were trained together. The system admin was included in all training sessions because he have full access to the whole system and should be familiar with the whole system. Clarification was made on all questions raised by the users.

5.4.2 PHASED CONVERSION

Phased conversion involves replacing the old system by the new system in phases. Phased conversion allows the users of the system to be trained gradually as they would only need knowledge of the recently installed phase. Error identification is easy as the analyst will be dealing with only a single phase. Failure in one phase may not affect the other phases. The analyst did not make use of this method because of the disadvantages associated with it. This method is more expensive as compared to direct changeover because each phase should be tested separately until all the phases are complete. Implementing the system in phases will take a long time to implement the whole system. This means the method cannot be used in urgency situations. This method only works if the system can be split into various parts.

5.4.3 DIRECT CHANGEOVER

Palm (2016) asserts that direct changeover is whereby the old system is directly replaced by the new system. Direct changeover is the fastest way of replacing the old system. The new system will be used immediately after replacing the old one. Chances of getting errors from the system

are less as the system will have been fully tested. The analyst did not use direct changeover because of the risks associated with it. If the newly implemented system fails, there will be work stoppages due to delays encountered in reverting to the old system.

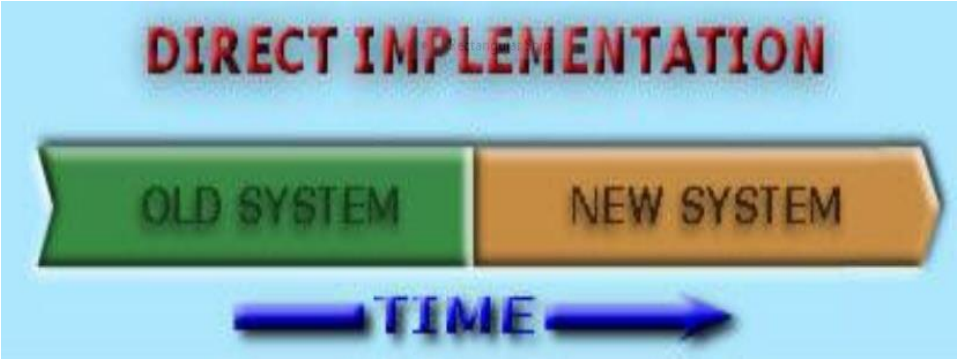


Fig 5.4 Direct changeover method

Source: Smark (2010)

5.4.4 PARALLEL RUN (RECOMMENDED CONVERSION METHOD)

Kendall (2012) defines parallel run as running the old system and the newly developed system side by side for a specific period of time. Two sets of results will be obtained because same data will be inputted in both systems. The analyst used parallel run conversion because of the merits associated with it. The two system were compared together and it was found that the newly developed system was more efficient. The two systems were run parallel for a period of one month and the newly developed system proved to be worthy as it aided business processes. After a period of one month the old system was completely removed.

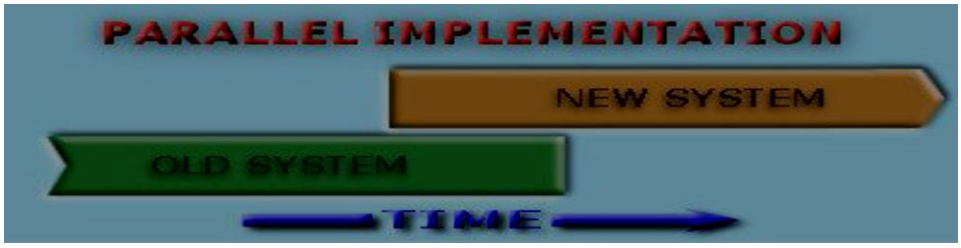


Fig 5.21 Parallel Implementation

Source: Smark (2010)

5.5 MAINTENANCE

Dexter (2010) defines system maintenance as a continuous process of making sure that the system is intact and operating as expected. Maintenance is an ongoing process which starts after the system is installed and only ends when the system is to be replaced. The developed system has to be integrated with current technologies such as emails, texts, google maps, and swiping machines. The system should be periodically upgraded and modified. Corrective and adaptive maintenance are being implemented on the system.

5.5.1 CORRECTIVE MAINTENANCE

Dexter (2010) defines corrective maintenance as a process of identifying errors on the system and fix them by replacing fault components. Lower costs are incurred because only the fault component is replaced. This does not require more staff and can be carried out with one or two people. This type of maintenance encompasses replacing broken Ethernet cables, replacing fault RAM chips and replacing old computers. Upgrading the software may sometimes require an upgrade on the hardware because the hardware requirements will change for each version of the software.

5.5.2 ADAPTIVE MAINTENANCE

Palm (2016) defines adaptive maintenance as a process adding for functionality to the system so that it meets the current demands. The system should be integrated with current technologies. For this to be achieved, modern programming languages should be used and it is crucial to build part of the system with android to enable accessibility on mobile devices. Object oriented programming paradigm should be used as they shorten the code and makes it easy to add functionality to an existing system. Hardware should also be upgraded to increase efficiency in processing data. Computers with more RAM of at least 8 GIG are preferable and with processor speed of at least 2.5 Gigahertz. As the needs of an organization may change, the system should be modified to meet those needs.

5.5.3 PERFECTIVE MAINTENANCE

Hether (2011) posits that perfective maintenance encompasses modifying a software after deploying it to the hardware where it will be operated on to enhance practicality and process

execution. Part of the software may be modified to achieve this. Changes that can be made include modifying how errors are handled, providing helpdesk and providing a more interactive input form.

5.6 RECOMMENDATIONS

Verification and validation testing methods were applied to the system and it was concluded that the system could be used. Maintenance should be continuously carried out on the system so that the system will be compatible with emerging technologies. The programmers should also update the source codes through use of new functions and classes. This will also enhance security on the system. Hardware should also be upgraded to ensure compatibility between hardware and software. Users are required to stick to what they were taught during training of how to use the system. Passwords should be frequently changed and not disclosed to anyone. ZETDC is also recommended to develop a mobile application that can be used by customers to report faults.

5.7 CONCLUSION

Users at ZETDC have been given time to test the system and were amazed by the functionality which the system offers. They stated that the system was above standard and offered functionality that was beyond their expectation. All users of the system were trained for them to get adequate knowledge on how to use the system. Unit testing, module testing, system testing and acceptance testing were applied to the system. Parallel run conversion method was used to implement the new system.

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APPENDIX A: USER MANUAL

The user manual is a high level view of the functionality of the system designed to help users cope up with the easy accessibility of the system. User's manual consists of all set of modules necessary to grant users privileges in accessing the system. This User manual will present all the functionality of the system.

GETTING STARTED

Electronic Energy Meter Management System is an electronic system that manages the Energy Meter by considering the customers consumption rates. To access the system, open a web browser of your choice and type 'localhost/zetdc' in your address bar and press enter. You will be directed to the home page.

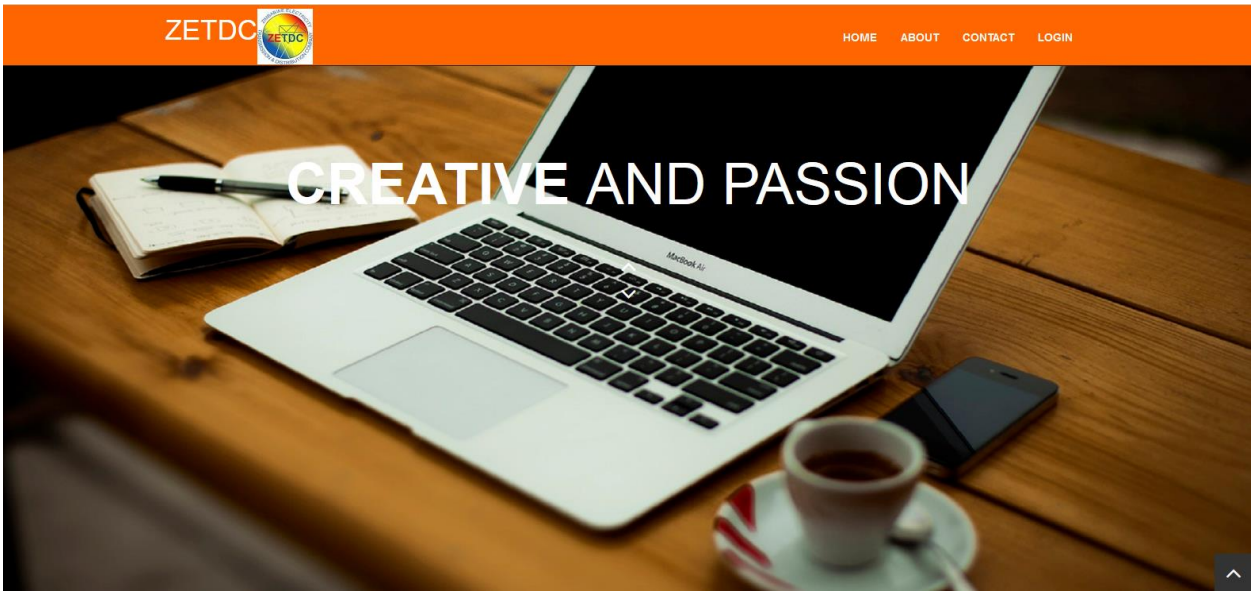

Figure A1: Home Page

To enter into the system, click the login hyperlink and you will be directed to the login page

Logging into the system

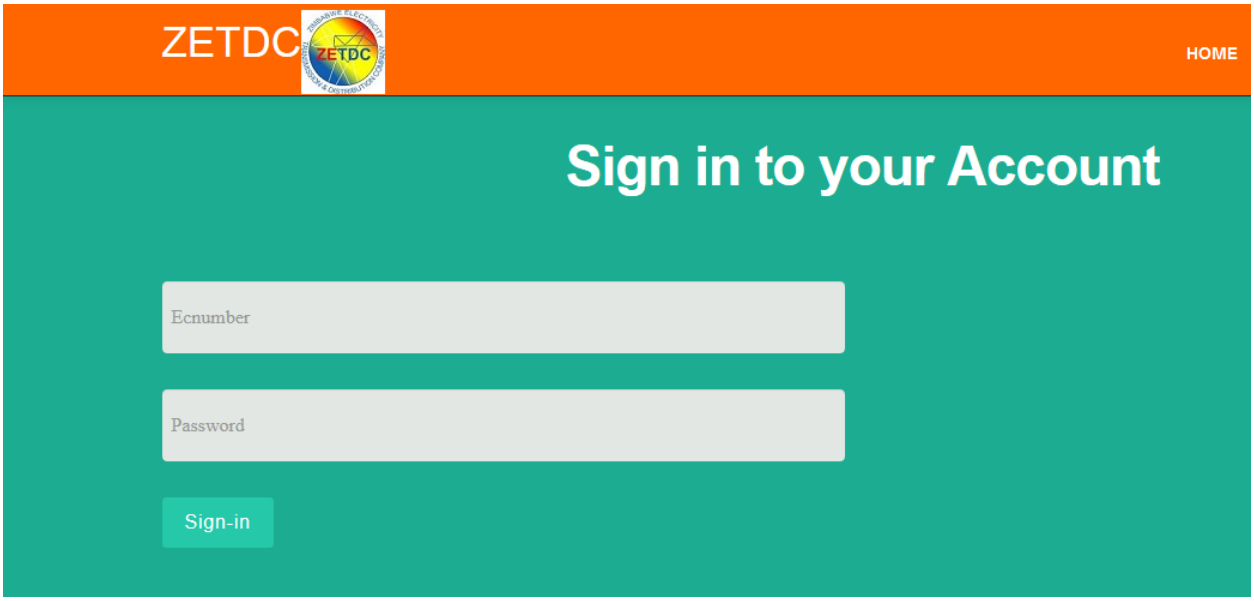

Figure A2: Login Form

All system users log in through this form but they will be directed to different platforms depending on the user's access level. The user should input the correct ecnumber and password to be directed to the main form.

Adding Users

The system administrator is responsible for adding users. He or she can add, update or delete users.

Figure A3: Add User Form

Changing Password

Every user is free to change his/her login password

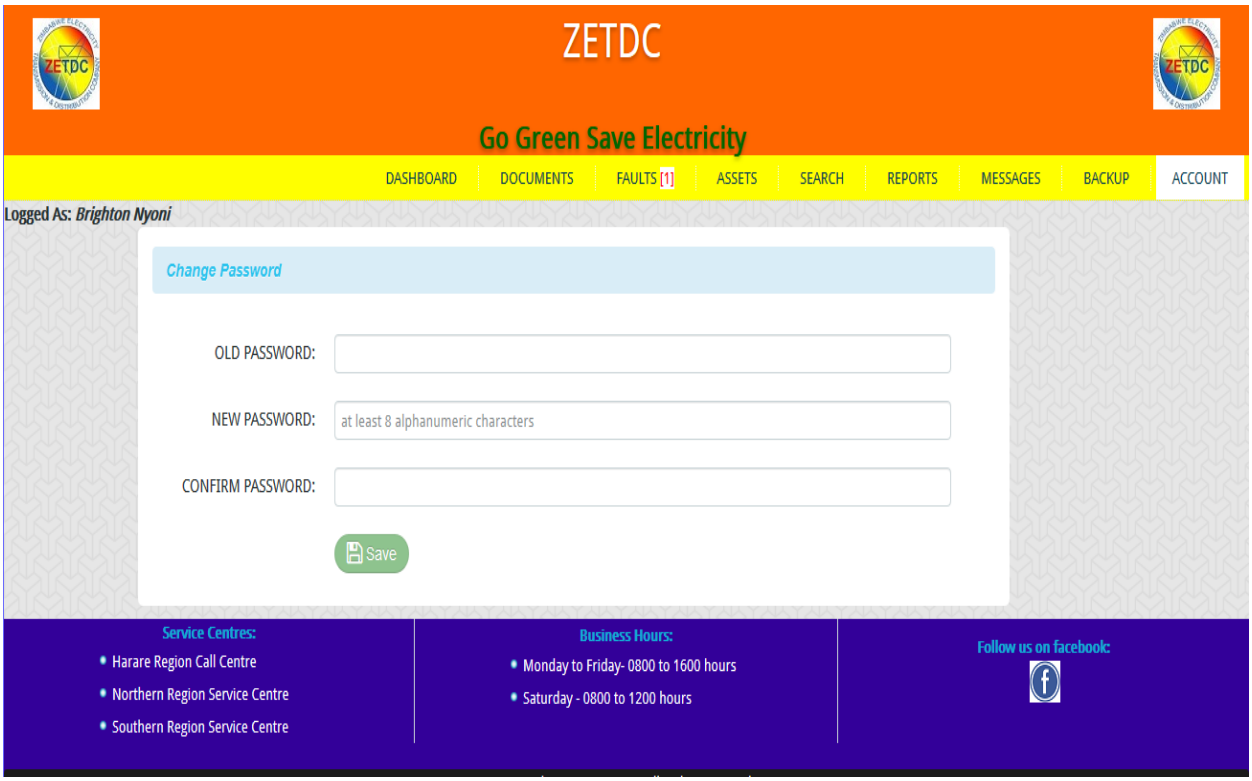

Figure A4: Change Password Form

Registering Customers

The clerk is responsible for registering new point of connection

Figure A6: Register Customer Form

The clerk also receives payments from customers

Figure A7: Search Meter Number Form

The clerk enters the customer's meter number and if its valid the payment form is accessed

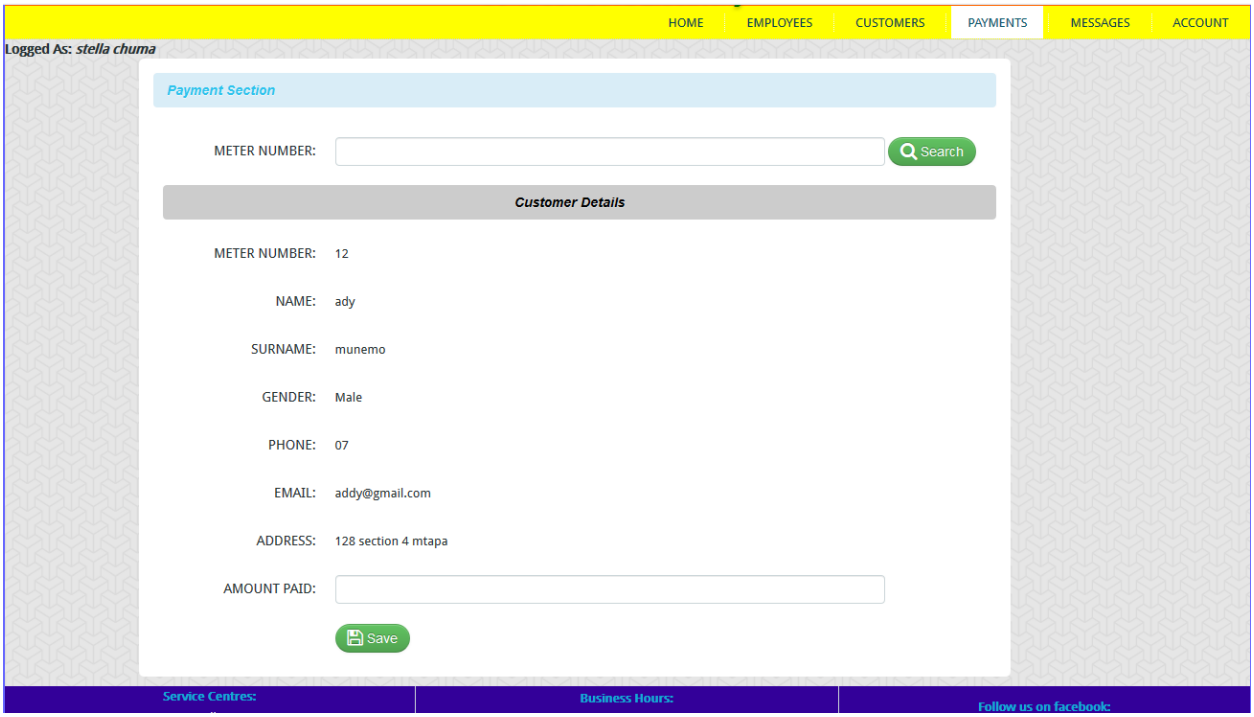

Figure A8: Payment Form

APPENDIX B: INTERVIEW CHECKLIST

PLACE……

DATE…….

DEPARTMENT INTERVIEWED

ZETDC MANAGEMENT

1. How do you view the current system in your own opinion

.....

.....

.....

.....

2. What can you say about the current system's performance?

……

……

……..……..

3. How do you restrict access to files which contain sensitive information?

……

……

……

4. What actions can't you do with the current system?

……

……

……

5. What would you want the new system to incorporate?

……
……
……

6. Any recommendations or suggestions to the development of the new system?

……
……
……
……

7. Explain the major problem that you have faced so far with the old system?

……
……
……
……

APPENDIX C: QUESTIONNAIRE CHECK LIST

PLACE …….

DATE…….

EMPLOYEES

Please tick where it is applicable

1. Do you think the current system is reliable, efficient and contributing to your organizational objectives and goals effectively?

Excellent system ☐ Fair ☐ Ineffective ☐

2. Do you often experience very busy days and big workloads during your operations?

Very often ☐ infrequently ☐ All the time ☐

3. Have some employees complained about the current system's performance?

Yes ☐ No ☐ A few ☐

4. Have there been delays caused by the old system?

Yes ☐ No ☐ A few ☐

5**.** Are you pleased with the processing speed of the current system?

Yes ☐ No ☐

APPENDIX D: OBSERVATION SCORE SHEET

OBSERVATION SCORE SHEET

NAME OF THE OBSERVER ……

DATE OF OBSERVATION ……

TIME OF OBSERVATION ...……

PLACE OF OBSERVATION ……

OBJECT BEING OBSERVED ……..

OBSERVATION……

……

……

……

……

……

……

……

……

CONCLUSION

……

……

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APPENDIX E: SNIPPET OF CODE

```
<?php
    error_reporting(0);

        $today=date('Y-m-d');

    $dbcon = mysqli_connect('localhost','root','','mire');

    function clean($str)
          {
        $str = trim($str);
        $dbcon = mysqli_connect('localhost','root','','mire');
    return mysqli_real_escape_string($dbcon, $str);
    }

        function success_message($message)
        {
        echo '
    <span class="ajax_notification dismissable" id="ajax_message_num_31">
    <div class="success"><img src="icons/s_okay.png" title="" alt="" class="icon
ic_s_success">'.$message.'</div>
    </span>';
        }

        function error_message($message)
        {
        echo '
    <span class="ajax_notification dismissable" id="ajax_message_num_31">
    <div class="error"><img src="icons/s_error.png" title="" alt="" class="icon
ic_s_error">'.$message.'</div>
    </span>';
```

```
        }
    ?>

<?php
    error_reporting(0);
        ?>

    <!DOCTYPE html>
    <html dir="ltr" lang="en-US">
    <head>
    <meta charset="utf-8">

    <title>Sign in | ZETDC</title>

    <meta name="viewport" content="initial-scale = 1.0, maximum-scale = 1.0, user-scalable = no, width = device-width">

    <?php include_once('head_infor.php'); ?>

    <style type="text/css">
        .art-sheet
        {
            vertical-align:central; margin-top:150px; width:700px; background-image:url(images/white.JPG);
        }
        </style>

    </head>
    <body onload="JavaScript:AutoRedirect(5000);">

    <div id="art-main">
```

```
<div class="art-sheet clearfix">

<center>

<h2 class="art-postheader" style="margin-left:0; border-radius:15px">Sign in to your account</h2>

<div style="margin:50px; width:600px;">
<form class="form-horizontal" id="myForm"  method="POST" action="process_login.php">

<div class="control-group">
<input type="text" name="ecnumber" id="ecnumber" placeholder="Ecnumber" autocomplete="off" autofocus required>
</div>

<div class="control-group">
<input type="password" name="password" id="password" placeholder="Password" required>
</div>

<div id="ack"></div>

<div class="control-group">
<button id="submit" name="login" class="btn btn-success"><i class="icon-signin icon-large"></i> Sign in</button>
</div>
<br><br>
</form>

    <script type="text/javascript" src="scripts/jquery-1.11.2.min.js"></script>
<script type="text/javascript" src="scripts/my_script.js"></script>
```

```
    </div>
    </center>
    </div>
    </div>
    </body>
    </html>

<?php
    error_reporting(0);
    session_start();
          require("../mydb.php");
          include_once('../functions.php');
         ?>

          <?php
          include_once('header.php');
          ?>

    <div class="art-layout-wrapper">
    <div class="art-content-layout">
    <div class="art-content-layout-row">
    <div class="art-layout-cell art-content">
    <article class="art-post art-article">

    <h5>Logged As: <em><?php echo @$_SESSION['name']; ?></em></h5>

    <div class="art-postcontent art-postcontent-0 clearfix">
    <div class="art-content-layout">
    <div class="art-content-layout-row">
    <div class="art-layout-cell layout-item-0" style="width: 100%" >
```

```
<div class="addrequest" style="border-radius:5px; padding:5px">

<h2 class="details">Assign Faults</h2>

<center><h4 style='color:#F00' id="ack"></h4></center>

<form class="form-horizontal" action="<?php $_PHP_SELF ?>" method="POST" enctype="multipart/form-data" style=" padding-right:10px">

<div class="control-group">
<label class="control-label" for="inputEmail">Technicians:</label>
<div class="controls">
    <select name="technician" class="chzn-select" required/>
     <option></option>
        <?php
            require("../mydb.php");
        $result = mysqli_query($dbcon,"select * from employees,users where employees.ecnumber=users.ecnumber and access=2")or die(mysqli_error($dbcon));
                while ($row=mysqli_fetch_array($result)){ ?>
                <option value="<?php echo $row['ecnumber']; ?>"><?php echo $row['name']." ".$row['surname']; ?></option>
                <?php } ?>
                </select>
</div>
</div>

        <div class="control-group">
            <div class="controls">
            <button name="Submit" id="submit" type="submit" class="btn btn-success"><i class="icon-save icon-large"></i> Assign</button>
            </div>
```

```
                </div>
</form>

</div>
</div>
</div>
</div>
</div>
</article>
</div>
</div>
</div>
</div>

<?php include_once('../footer.php'); ?>

    <?php

if(isset($_POST['Submit']))
        {
require("../mydb.php");
        $technician =  $_POST['technician'];

        $query = "UPDATE faults SET fixer='$technician' where id = '$_GET[fault_id]'";
$result = @mysqli_query($dbcon, $query);

if($result){
?>
<script language="javascript">
alert("Fault Assigned");
parent.location = 'faults.php'
```

```
</script>
<?php
	exit();
}

	//free the memory used for result, $result1 and $result2 sets
	@mysqli_free_result($result);
@mysqli_close($dbcon);
}
?>
```