BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

TRANSFORMER POWER PROTECTION AND ALERT SYSTEM.

BY

MUHANGI USTAS

BU/UG/2011/823

EMAIL: muhangiustas@gmail.com

Tel: +256-776-373-326

SUPERVISOR:

MR. BWIIRE FELIX

A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF COMPUTER ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR'S DEGREE IN COMPUTER ENGINEERING OF BUSITEMA UNIVERSITY.

MAY, 2016

DECLARATION

I **Muhangi Ustas,** Reg No**. BU/UG/2011/823** solemnly, do here by, declare to the best of my knowledge that this project proposal with all its contents was done by only me and I would like to point it out that, no one has ever presented or duplicated this proposal or with any of its contents at any institute of higher learning.

Signature ……. Date …….

APPROVAL

This is to approve that this Project under the title TRANSFORMER POWER PROTECTION AND ALERT SYSTEM has been fully and consistently worked on and submitted to the department of computer engineering under the supervision of University Supervisor:

Mr. BWIIRE FELIX

Signature: 

Date: **…….**

ACKNOWLEDGEMENT

First and foremost I thank the almighty God who gave me strength and good health throughout the semester

I extend my thanks to my dear parents, Mr. and Mrs. Mpirirwe Gordon for their love, finances and moral support given to me throughout my life.

My supervisor Mr. Bwiire Felex; thank you very much for the wonderful work you have done concerning the completion of this project report. May the Almighty God richly bless you.

In special way, I extend my thanks to Mr.Arineitwe Joshua, who provided me the advises, knowledge & technical skills. Thank you very much.

Special thanks also goes to my family members Mrs. Tushabe Beteth and Muhunguzi Einsten who have always financed me in different endeavors as regards my Education is concerned. Your support is highly appreciated.

To my friends who sacrificed their time, money and knowledge and engaged in discussions as regards the successful development of my project; especially the outstanding Mr. Dembe Wycliff, Mr.Amumpe Esau, Mr. Asiimwe Pison, Mr. Kato Amon and among many others I say bravo!

I thank my brothers, sisters and friends outside Busitema University for being good to me. A rapturous applause should be extended to Edson, Mercury, Cathbert, Smartson, Joan, Brain and Brighton for helping me to always think positive about life.

I also thank the administration of Busitema University, Computer Engineering Department for the skills they have given me may God award you all abundantly.

Finally, credit goes to acknowledge my classmates, friends and relatives for the prayers, efforts and guidance, you have given to me during the course of this project. MAY GOD BLESS YOU ALL A BUNDANTLY.

ABSTRACT

The main intention of this project is to design and Implement a system that can be used in power transformer protection and alert system. The system checks the operating parameters of the transformer i.e. current and reports the quantity that is flowing through the transformer. The system is designed such that it is able to detect currents above the normal operating level and isolate the power transformer from the distribution line. This isolation process is to ensure that the transformer is safe from any excess current levels that can make it to overheat thus get damaged. It gives a solution to the need to reduce cost of maintenance and ensure that supply of electricity to consumers is not interrupted for long periods taken while repairing or replacing destroyed transformers.

A current sensor ACS712x series has been used in this project as the interfacing instrument between the power transformer and the Atmega328.p microcontroller. Atmega328.p controls all operations that the device does. A relay and a contactor have been used as the switching gears to isolate the transformer from the power system in case a fault occurs. A monochrome LCD has been used to show system current readings and indicate cases of over-current fault. To warn an operator of a fault occurrence, LEDs and a piezoelectric buzzer have been used. All these peripheral devices depend on the microcontroller to make them operate or otherwise. Some of the tools used in this project include MPLAB - programming software used to write the program for the microcontroller used in this project. Proteus- simulation software has also been used to test whether the design works appropriately before its implementation on hardware. Pickit3- has been used to load program into the microcontroller using MPLAB.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF ACRONYMS

ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
DC	Direct Current
AC	Alternating Current
IC	Integrated Circuit
FETS	Field Effect Transistor
LDR	Light Dependent Resistor
LED	Light Emitting Diode
LCD	Liquid Crystal Display
kV	Kilo Voltage
VSM	Virtual Simulation Module
CPU	Central Processing Unit
UPS	Uninterruptible Power Supply
Hz	Hertz
GSM	Global System for Mobile Communications
Op amps	Operational Amplifier

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

It is clear that over time, there has been an increase in human population, economic growth and technological advancement. This has continuously made the demand for electrical power to go high because as technology, human population and economy grows; there is an increase in demand for power as many more electrical loads are introduced into the supply line. An increase in load leads to a lot of current drawn from the power line. At times the demand goes above what the power distributor can supply. The consequence of this is that electrical power overload cases become common thus posing danger to power system components.

In the design of electrical power transmission and distribution system, there are various factors that need to be considered in the quest to satisfy the needs of electricity consumers. Electrical power systems experience faults at various times due to various reasons. These faults must be foreseen and safety precautions applied to the power system. The power systems engineer must include in his design, safety measures in order to avert any destructive occurrences that the system may undergo at any given time. Power system protection is very essential and necessary for a dependable electrical power supply. It ensures that the system is protected from itself and that the consumer is also safe as he benefits from the electrical power supply. An electrical power system consists of various components such as generators, switches, transmission cables, transformers, capacitor banks among other components. It cannot therefore operate without an effective protective device to keep these components safe and the system stable. Faults in a power system refer to the undesired conditions that occur in the electrical power system. These conditions may include short circuit, over current, overvoltage, high temperatures among others.

This therefore throws in the need for devices that can monitor the rate of power consumption in accordance with the level that a given system is designed to sustain. Such a device must be designed to cut off consumption if the system oversteps its ability thus being dangerous to users and the components. In this project, we look at the protection of power transformer from various faults that may occur and may be destructive to the component if left undetected. The transformer is a very important component in an electrical power system as distribution of electrical power to consumers is more efficiently effected. Every transformer is designed to comfortably supply a given load. Cases of overload or short circuits can lead to transformer being damaged. To combat

such occurrence, an elaborate system that monitors these excesses in supply parameters needs to be built. Such a device controls the flow of electrical power to the load so that the transformer is not overworked. Over current relays and overvoltage relays have been used for a long period of time and have been electromechanically controlled. In this system, a microcontroller is used to monitor cases of electrical faults and communicate to a switch to isolate the transformer from the system.

1.2 PROBLEM STATEMENT

Due to over-voltage in primary windings and over-loading in the secondary windings, many step-down transformers used in distribution systems have ended up blowing. This results in power consumers being in a blackout until an appropriate replacement of the affected transformer is done. The concerned people from power center end up not knowing what has happened to the transformer and it is very hard to repair or replace the damaged transformer. This system therefore, protect a transformer from both over-voltage and over-loading in primary and secondary windings respectively and giving some consumers opportunity to remain using ac power from backup battery when the transformer is off and alerting the concerned person from the power center.

1.3 OBJECTIVE

1.3.1 General objective

The main objective of this project was to design and implement a system that uses microcontroller and other peripheral devices to protect power transformer and alert system.

1.3.2 Specific objectives.

1. To determine the failures and implications of transformer power protection and alert system.
2. To design and implement an over current relay using microcontroller and a current sensor
3. To develop ADC program for convert and LCD program for displaying the sensed levels and relay control system program.
4. To test and validate the designed system

1.4 JUSTIFICATION

Power transformers are key components for electrical energy transfer in a Power system. Burning of a Step-down transformer is a serious problem due to an undesirable condition occurs in the

power system. In order to protect the transformers from over-voltage and over-loading different protective methods are adopted [6].

Power sensors is used for the Power Transformer Protection. It is sensing the over-voltage and over-loading of about +5% from normal voltage and send signal to microcontroller to trip the relay, driver circuit and the power transformer will automatically get isolated from the system. The aim reason is to provide an alternative, effective, efficient and more reliable method of protecting fault from power transformer which may arose as a result of overload, high temperature or a high input voltage. Generally, fault may occur in transformers due to the stated reasons. To safeguard the damage of the transformer with the aid and help of microcontroller, Am monitoring and controlling the entire circuitry [7]. Thereafter regarding the monitoring and control, information about the operation of the parameters will be sent to a power Centre (UMEME Offices) for alerting them what has happened to the transformer. This will avoid the need of the lines men who will go to the transformer station without knowing what has happened. Lastly, a working system will ensure that the power consumers will be on using A.C bank up power when the transformer will be off. The statistical data in form of voltage levels of the backup power will be alphanumerically displayed on an LCD. This data can be used to define the efficiency and degree of reliability of the battery. The alarm will notify the end user that they are on backup power basing on the statistical data of voltage variations

1.5 SCOPE

1.5.1Technical scope

The investigation carried out in this project was limited to power transformer protection methods. The extent of the work is to build a device that detects current spikes/overload in the primary and secondary sides of a single phase transformer and isolate it from the power system**.**

1.5.2 Geographical scope

The system is only focus on the places where transformers are serviced ie in power Centers, and where there are technical expertise for maintaining / installing transformer in case of any problem.

1.5.3 Time scope

The project is developed for a period of 5 months and is now ready for use.

1.6 LIMITATIONS

- Since it is not monitoring system based, real time monitoring of transformer is not possible.
- Also the system is not in position to keep records of transformer behavior as it is not a data logger.
- Absence of electronic laboratories in and around Busitema University made it expensive to develop my system.
- Limited funds / finances to facilitate me in making movement in trying to access components and experts.
- Limited access to e-resources most especially internet facilities at Busitema main campus.

APPENDIX

REFERENCES

[1]. (Jyotishman Pathak), "A Service-Oriented Architecture for (Electric Power Transmission System Asset Management)", In ICSOC Workshops, pp: 26-37, 2006.

[2]. (The second edition of the Handbook of Electrical Design Details(HEDD)) National Electrical Codeand NECare registered trademarks of the National Fire Protection Association, Quincy, Massachusetts.Copyright 2003, 1997 by The McGraw-Hill Companies

[3]. B. A. Carreras, V. E. Lynch, D. E. Newman and I. Dobson, "Blackout Mitigation Assessment in (Power Transmission Systems)", Hawaii International Conference on System Science, January 2003.

[4]. Xiaomeng Li and Ganesh K. Venayagamoorthy, "A Neural Network Based Wide Area Monitor for a Power System", (IEEE Power Engineering Society General Meeting), Vol. 2, pp: 1455-1460, 2005.

[5]. Argonne National Laboratory, " (Assessment of the Potential Costs and Energy Impacts of Spill Prevention, Control, and Countermeasure equirements for Electric Utility Substations)", Draft Energy Impact Issue Paper, 2006.

[6]. R.R. Negenborn, A.G. Beccuti, T. Demiray, S. Leirens, G. Damm, B. De Schutter and M. Morari, " (Supervisory hybrid model predictive control for voltage stability of power networks)", Proceedings of the 2007 American Control Conference, New York, New York, pp: 5444-5449, July 2007.

[7]. P.Daponte, M. Di Penta and G.Mercurio, " (TRANSIENTMETER: A Distributed Measurement System for Power Quality Monitoring)", IEEE Transactions on Power Delivery, Vol. 19, Issue. 2, pp: 456-463, 2004.

[8]. G. Pudlo, S. Tenbohlen, M. Linders and G. Krost, " (Integration of Power Transformer Monitoring and Overload Calculation into the Power System Control Surface)", IEEE/PES Transmission and Distribution Conference and Exhibition, Vol. 1, pp: 470-474 Asia Pacific, 2002.

[9]. Zhi-Hua Zhou, Yuan Jiang, Xu-Ri Yin, and Shi-Fu Chen, " (The Application of Visualization and Neural Network Techniques in a Power Transformer Condition Monitoring System)", In: T. Hendtlass and M. Ali eds. Lecture Notes in Artificial Intelligence 2358, Berlin: Springer- Verlag, pp: 325-334, 2002.

[10]. Overbye and Weber, " (Visualization of power system data)", in proceedings of 33rd Annual Hawaii International Conference on System Sciences, January 2000.

[11]. Johan Driesen , Geert Deconinck, Jeroen Van Den Keybus, Bruno Bolsens, Karel De Brabandere, Koen Vanthournout, Ronnie Belmans, " (Development of a Measurement System for Power Quantities in Electrical Energy Distribution Systems)", in proceedings of IEEE Instrumentation and Measurement Technology Conference, Anchorage, AK, USA, May 2002.

[12]. Humberto Jimenez, Hugo Calleja, Raúl González, Jorge Huacuz and Javier Lagunas, " (The impact of photovoltaic systems on distribution transformer: A case study)", Energy Conversion and Management, Vol.47, No.4, pp.311-321, March 2006.

[13]. Sen Ouyang and Jianhua Wang, " (A new morphology method for enhancing power quality monitoring system)", International Journal of Electrical Power & Energy Systems Vol.29, No.2, pp.121-128, February 2007.

[14]. Alessandro Ferrero, " (Measuring electric power quality: Problems and perspectives)", Measurement, Vol.41, No.2, pp.121-129, February 2008.

[15]. Antonio Ginart, Irtaza Barlasa, Sashank Nanduria, Patrick Kalgrena and Michael J.

[16] Research paper- (Transformer-health-condition-monitoring through GSM-technology) (Vadirajacharya.K, Ashish Kharche, Harish Kulakarni, Vivek Landage) [accessed on 12/01/2014].

[17].Tenbohlen, M. Linders and G. Krost, "Power Transformer Monitoring and Overload Calculation into the Power System Control Surface".

[18].Yuan Jiang, Xu-Ri Yin, and Shi-Fu Chen, "The Application of Power Transformer systems and Neural Network Techniques in a Power Transformer Condition Monitoring System", In: T. Hendtlass and M. Ali eds. Lecture Notes in Artificial Intelligence 2358, Berlin: Springer- Verlag, pp: 325-334, 2002.

[19]. Chi Hang Ip (u4068654) Wenhai Huang (u3931944) ENGN3227 Group Project "Integrated Sensing System for Housing Appliances" Prepared By Ahmed Arif (u4189763), Submitted to Dr. Salman Durrani Date: 24 October 2006

[20]. Shoichi Oda Eisuke Nakahara Rikiro Koriyama Hisashi Yamaguchi I saD Sakamoto Yokuya Fujisawa"Electricity transformer" The Institute of Vocational Training .The Employment Promotion Projects Corporation .The Ministry of Labour, Japan in Japan3456378-098. 2012