UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SUBSTATION TRANSFORMER MONITORING SYSTEM USING GLOBAL SERVICE MOBILE (GSM)

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

By

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I hereby, declared this report entitled SUBSTATION TRANSFORMER MONITORING SYSTEM USING GLOBAL SERVICE MOBILE (GSM) is the results of my own research except as cited in references.

Signature: ……

Author : MUHAMMAD NUR AZWAN BIN MOHD NASIR

Date:

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor : PROF MADYA MOHD ARIFF BIN MAT HANAFIAH

ABSTRAK

Projek ini adalah mengenai reka bentuk dan pelaksanaan sistem terbenam mudah alih untuk memantau dan merakam parameter utama pengubah pengedaran seperti tahap minyak dan suhu operasi. Idea sistem pemantauan dalam talian mengintegrasikan Modem perkhidmatan mudah alih global (GSM), dengan pengawal mikro cip tunggal dan sensor yang berbeza. Ia dipasang di tapak transformer pencawang dan parameter yang digunakan adalah untuk merekod menggunakan analog ke penukar digital (ADC) sistem terbenam. Maklumat yang diperoleh diproses dan direkodkan dalam memori sistem. Sekiranya ada sesuatu yang tidak normal atau kecemasan berlaku, sistem menghantar mesej pesanan ringkas (SMS) kepada telefon bimbit yang mengandungi maklumat tentang system tidak stabil mengikut arahan yang telah ditetapkan dan diprogramkan di dalam pengawal mikro. Sistem mudah alih ini akan membantu transformer beroperasi dengan lancar dan mengenal pasti masalah sebelum sebarang kegagalan bencana.

ABSTRACT

This project is about the design and implementation of a mobile embedded system to monitor and record key transformer parameters such as oil level and operating temperature. The idea of an online monitoring system integrates the Global Service Mobile (GSM), with a single micro-chip controller and different sensors. It is installed on the substation site and the parameters used are to record using the analogue system to the digital converter (ADC). The information obtained is processed and recorded in the memory system. In the event of an abnormal or emergency, the system sends a short message (SMS) to the mobile phone which contains information about the system which is not stable according to the instructions set and programmed in the micro-controller. This mobile system will help transformers operate smoothly and identify problems before they occur.

DEDICATION

To my beloved parents who support me through thick and thin.

ACKNOWLEDGEMENTS

The completion of this research could not have been possible without the participation and assistance of many people. Their contributions are well appreciated and acknowledged. I would like to express my gratitude to my supervisor, Professor Madya Mohd Ariff Bin Mat Hanafiah for his support and advises during conducting this project. To my family, friends and others that shared their support either financially or morally, thank you.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discusses the context of this plan, the statements of problems, objectives, and conclusions. The structure of this report will be described and an overview of the whole project will be explained.

1.2 Background

Abnormality is station in an electrical device are accompanied by variations in numerous parameter like temperature winding, prime and the low temperature of the oil, temperature closure, load current, the flow of oil (pump motor), gas humidity, gas dissolved, bushing state, Load Tap Changer (LTC) observance, oil stage. All the same, managing oil level and temperature.

Internet observance system consists of embedded system, Global Service Mobile (GSM) electronic equipment, mobile users, and GSM networks and sensing element mounted on electrical device website sensor are installed on transformer aspect which reads and measures the station's physical amount in transformer and converts it to analog or virtual signal. The embedded module can be found on the website of the electrical device. It is used for the GSM electronic equipment to collect, process, display, transmit and receive the parameter. That's the GSM module, then it is the connection between the

embedded system and the public GSM network. It is also a utility module that requires a PC-based server that is located in the utility core. The server is connected to GSM electronic devices and received via the GSM module transmits SMS to the website of the electrical device.

1.3 Problem Statement

A transformer can be manually controlled where a person visits the transformer site regularly to conduct routine checks, perform maintenance tasks, or even check if the transformer is online or disabled. Such a method of control cannot provide information on various types of parameters of transformers.

1.4 Objective

This project aims to design online monitoring to monitor transformers at substation parameters and to send SMS to specified mobile devices and in the following cases:

- When the temperature at transformer reaches the high degrees.
- When the oil level reaches the low level.

1.5 Project Scope

The project scope has been dole out to realize the project objectives. Within the order to confirm that this project flow in keeping with its objectives, many work scope should be done. All this work scope and arrangements should be done among the project space. Below is a list of the scope of the project:

a) Analysis of GSM network information via SMS.

b) Identify and troubleshoot the program of Arduino.

c) Identify and troubleshoot the additional sensor.

d) Link the hardware and the software system.

1.6 Conclusion

This chapter consists of project background explanations, objective, problem statements and project scope. This section also addresses the issue to be solved and how the software and hardware design will be conducted.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides monitoring of the transformer using Global Service Mobile (GSM). It additionally contains some reviews concerning a transformer and GSM. The most supply of the study was taken from articles and journals. All sources are chosen consistent with the relevance of the project scope.

2.2 Review from articles and journals

Certain styles are created to form a watching system for transformers:

"Kumar, A., Raj, A., Kumar, A., Prasad, S. and Kumar, B. – (2012) have designed and implemented a mobile embedded system for monitoring and diagnosing transformer condition, recording main electrical device operating indicators such as electrical equipment fuel, near temperatures, and voltages. The digital monitoring system combines electronic GSM equipment with PLC (programmable logic controllers) and sets of devices. Knowledge of the electrical device's working state in several SMS (Short Message Service)." [1]

"Sachan, A. – (2012) has non-inheritable remote electrical parameters such as current, frequency, and voltage provided by GSM network victimization GSM modem/phone by power plant temperature. Additionally, his style aimed to safeguard the electrical electronic equipment by operational magnetic attraction relay. When the electrical parameters are more than the predefined values, the relay will be activated. His

system can also mechanically send the important time electrical parameters sporadically within the variety of SMS." [2]

"Surekha, N.,Kumar, A. and Figueiredo, D.– (2012) developed a monitoring system for the supply of electrical equipment by concentrating on the transformer and the oil body temperature. The purpose of this approach is to help the AVR microcontroller. Here the controller reads the temperature and body indefinitely and shows along with the stage on the LCD. If the current worth is crossing the point then the device can off and semiconductor diode is ON together with the fan (DC motor), and one alert message is shipped to the predefined range through GSM module." [3]

"Suresh, D., Prathibha, T. and Taj, K. – (2014) have in the centered on watching of electrical device oil by victimization PLC, SCADA with appropriate sensors for sensing parameters of oil like temperature and wetness content. Additionally, to the current, their system incorporated with the GSM module to alert the upkeep authority once the electrical device below goes faulty condition." [4]

"Nagaraju, N. and Kiruthika, M. – (2013) have designed a watching system that observes frequent power disconnections, power felony, power wastage. This method sends the standing of the electrical device through GSM. Also, their system has the ability to automatic sense ON/OFF street lights." [5]

"Pandey, R. and Kumar, D. – (2013) using the distributed electrical device networks remote monitoring system (DTRMS), a monitoring system was developed and designed to record and view parameters such as the oil level standing of an electrical device. The device is primarily based on a microcontroller with solid-state parts for operating sensors, backup power, clock and digital communication module that supported the ZigBee protocol." [6]

"Agarwal, M. and Pandya, A. – (2014) design of a mobile embedded system for monitoring and documenting the main activity of an electrical distribution device such as overvoltage, over-current, temperature, oil level drop. This method is intended to notify by sending and alerts using SMS whenever connected parameter worth is more than the predefined limits. They used a PIC microcontroller for continues reading sensors parameters." [7]

"Ranvir, K., Solanke, M., Ratnaparkhi, R., and Sable, A. – (2015) have developed an on-line watching and system. This method aims to monitor the electrical parameters of an electrical distribution device in an exceeding station and to provide protection against the burning of electrical distribution devices due to constraints such as overload, over-temperature, and high input voltage. If any of these values raise the cap on the far side, the entire unit will be packed into a magnetic attraction relay by operation. This relay is activated as presently because the parameters are more than the predefined threshold values. The GSM electronic equipment is employed to send the important time electrical parameters within the variety of SMS. The system is designed to notify the licensed person using SMS alerts when the parameters (voltage, current, and temperature) exceed the predefined limits." [8]

"Kharche, A., Vadirajacharya, K., Kulakarni, H. and Landage, V. – (2012) have developed a coffee value answer for watching health conditions of remotely settled distribution transformers victimization GSM technology. An embedded mainly hardware design is built to acquire electrical sensing device information. It has several functions such as a sensing system, electronic signal learning circuits, advanced embedded hardware for middle-level computing, a strong network for additional knowledge transfer to various locations." [9]

"Sarsamba, M.,Yanamshetty, "R. and Sangulagi, P. – (2013) have designed a system for monitoring GSM technology for load and power lines victimization SMS. This method is intended to enforce victimization embedded mobile system to monitor and record current and voltage fluctuations in wattage lines and it also controls the identical once line breaks throughout the high load. This digital monitoring system combines a Mobile Service (GSM) modem worldwide, face-up to the one-chip microcontroller and computer kit." [10]

2.3 Transformer and operation principle.

"A transformer is a static (or stationary) system that transforms electrical power in one circuit into electrical power of the same frequency in another circuit. It can increase or decrease the voltage in a circuit but with a corresponding reduction or increase in the current. A transformer's physical basis is the mutual induction of two circuits connected by a common magnetic flux." [11]

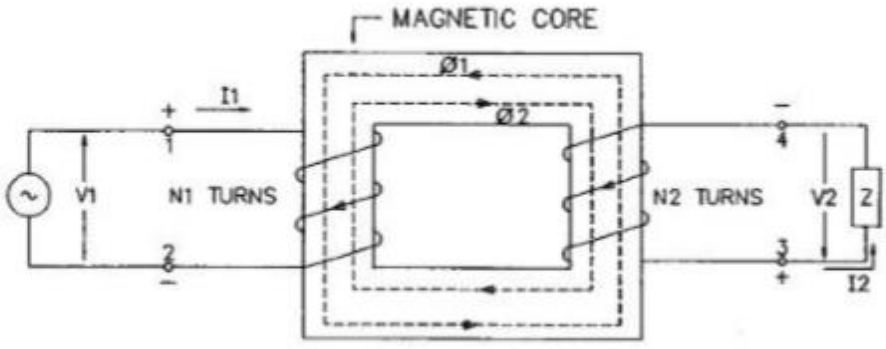

Figure 2.0: Electrical power transfer.

"The actual process of electrical power transfer from a voltage of V1 to a voltage of V2 is illustrated using the simplified representation of the transformer shown in Figure 2.0. Application of a voltage through the transformer's primary winding results in a magnetic field of approximately 1 Wb in the magnetic core, which in turn induces V2 voltage at the secondary terminals. V1 and V2 are synonymous with the equation V1/V2 = N1/N2, where N1 and N2 refer to the number of turns in the primary and secondary windings. If a load current of I2 A is drawn from the secondary terminals, the load current in the center defines a magnetic field of 2 Wb and the direction is shown. Since the load effect is to decrease the amount of the primary magnetic field, the decrease in I1 results in an increase in the primary current I1 so that the net magnetic field is almost restored to the initial value and the slight reduction in the field is due to magnetic flux leakage. The currents in the two windings are linked by the I1/I2 = N2/N1 expression. Since V1/V2 = N1/N2 = I2/I1, V1 · I1 = V2 · I2 is used. The volt-amperes in the two windings are therefore theoretically equal. In reality, during transformation, there is a slight loss of power due to the energy needed to set up the magnetic field and to overcome the transformer core and windings losses. Transformers are converters of static power and are therefore highly efficient. The efficiency of transformers is about 95% for small units (15 kVA and less) and the output of units above 5 MVA can be higher than 99%." [12]

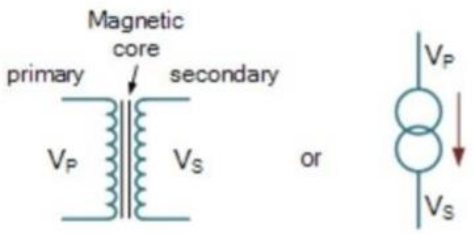

Figure 2.1: Transformer symbols

2.3.1 Ideal transformer:

"A transformer that has no loss is the ideal transformer model. This ensures the transformer's windings are strictly inductive and the transformer's center is loss-free. The transformer's leakage reaction is zero. Whenever a low reluctance core is inside the windings, the maximum amount of flux passes through this core, but some flux does not pass through the core but passes through the insulation used in the transformer. This flux is not part of the transformer's conversion operation.

This flux is called the transformer's leakage flux. This leakage flux is also called zero in an ideal transformer. It means that 100% flux passes through the middle and interacts with the transformer's primary and secondary windings. Although every winding is desired to be purely inductive but with some resistance, which results in a drop in voltage and a loss of I2R. The windings are also considered ideal in such an ideal transformer design, meaning that the winding resistance is zero. Now if an alternative source voltage V1 is applied in that ideal transformer's primary winding, there will be a counter self emf E1 induced in the primary winding that is strictly 180 ° in phase opposition with supply voltage V1.

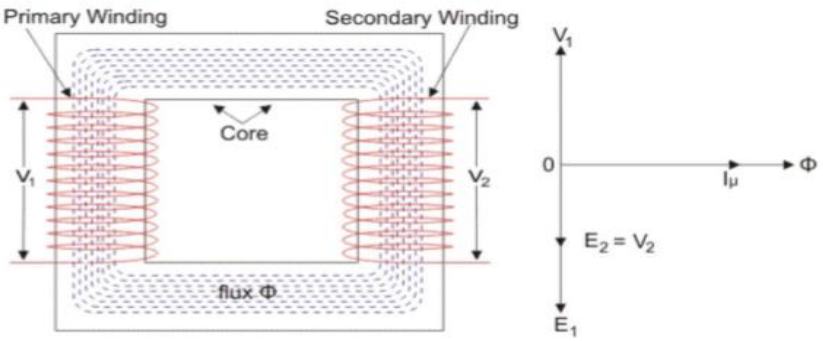

Figure 2.2: Secondary induced voltage in ideal transformer