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09 – 12

Review: Implementation of Wireless Sensor Network for Monitoring and Protection of High Voltage Transformer

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ABSTRACT: The paper proposes an innovative design to develop a system based on AVR microcontroller that is used for monitoring the voltage, current and temperature of a distribution transformer in a substation and to protect the system from the rise in mentioned parameters. Providing the protection to the distribution transformer can be accomplished by shutting down the entire unit with the aid of the Radio frequency Communication. Moreover the system displays the same on a PC at the main station which is at a remote place. Furthermore it is capable of recognizing the break downs caused due to overload, high temperature and over voltage.

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I. .INTRODUCTION

As discussed earlier, maintenance of a transformer is one of the biggest problems in the Electricity Board (EB). During strange events for some reasons the transformer is burned out due to the over load and short circuit in their winding. Also the oil temperature is increased due to the increase in the level of current flowing through their internal windings. This results in an unexpected raise in voltage, current or temperature in the distribution transformer. Therefore, we are proposing the automation of the distribution transformer from the EB substation. In the automation, we consider the voltage, current and temperature as the parameters to be monitored as the transformer shows its peak sensitivity for the same. Hence, we design an automation system based on microcontroller which continuously monitors the transformer. Because of the microcontroller operation, the transformer present in the substation which is turned off in the main station.

Distribution transformers have a long service life if they are operated under good and rated conditions. However, their life is significantly reduced if they are overloaded, resulting in unexpected failures and loss of supply to a large number of customers thus effecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformers.

II. LITURATURE REVIEW

2.1.1 Wireless Sensor Networks for the Protection of an Electrical Energy Distribution Infrastructure.

António Grilo, Augusto Casaca, Mário Nunes and Carlos Fortunato, INESC-ID/IST, R. Alves Redol, 9, 1000-029 Lisboa, Portugal

This paper investigates From a safety and security point of view, the electrical energy distribution infrastructure needs to be protected.. In this paper solutions to increase the safety aspects of substation components, power lines and power transformers are discussed. Also security solutions related to perimeter intrusion detection in substations and remote surveillance of power transformer installations are introduced. All the solutions are based on the deployment of wireless sensor and actuator networks in the substation, power lines and power transformers, which perform remote monitoring and provide alarms when required. The sensor network interacts with the SCADA system of the electricity provider to allow for centralised control of the protection system.

2.1.2 Design Wireless Sensor Network System to Power Management and Protect Electrical Pole Transformers by using Zigbee Model and Microcontroller

Muthanna Ali Saihood, K. Lakshmi Bhavani, M .Tech Student, ECE Department, College of Engineering & Technology, Acharya Nagarjuna University, Andhra Pradesh, India.

This paper discuss design and implementation wireless sensor network system is used for tow purposes , power management system and protection system. The power management system (PMS) is very important factor to manage and control the electrical power, This system consider important tools to safe the power consumption then due to this system can reduce the power consumption to minimum point, and also its charge of coordinate between power consumption capacity and power production capacity to avoid switch off the street lighting and emergency places such as hospitals. And automatic switch on and switch off the consumers diesel generators, by using successful management power can get to stable and efficient distribution power system.

2.1.3 ZIGBEE Wireless Transformer Monitoring, Protection and Control System.

Ravishankar Tularam Zanzad, Prof. Nikita Umare , Prof. Gajanan Patle ,M. E. Student, Dept. of CSE, AGPCE, Nagpur University, IndiaProfessor, Dept. of CSE, AGPCE, Nagpur University, India

This paper investigates, In normal ways all the Industrial or Electrical machineries are controlled by the manual operation. Hence there is step by step progress but most of the time there is not actually instant co-operation between system and operator in case of emergency or fault type situation .Therefore we are designing a system where there exits communication between system and operator. For this we are using Transformer, microcontroller, analog to digital converter.. As we know Distribution transformer is a major component of power system and its correct functioning is vital to system operations. To reduce the risk of unexpected failure and the ensuing unscheduled outage, on-line monitoring has become the common practice to assess continuously the condition of the transformer with.

2.1.4 Wireless Sensor Network for In-Field Operation Monitoring Of Induction Motors

Satpute A.P. Student, Prof. Miss V.A.More, Assistant Professor, E&Tc Dept, MGM's Jawaharlal Nehru Engineering College, Aurangabad

Induction machines play a pivotal role in industry and there is a strong demand for their reliable and safe operation. They are generally reliable but eventually do wear out. Faults and failures of induction machines can lead to excessive downtimes and generate large losses in terms of maintenance and lost revenues, and this motivates the examination of condition monitoring.

2.1.5 Wireless Sensor Network Performance In High Voltage And Harsh Industrial Environments Inam-Ul-Haq Minhas.

Degree of Master of Science in Electrical Engineering, Blekinge Institute of Technology.

The applications of wireless sensor networks, WSN, are getting popular in the different areas reaching from daily usage to industrial usage. The performance evaluation of WSN deployed in industrial and high-voltage areas is receiving a great attention and becoming an interesting area of research. This thesis addresses the performance issues of WSN in high-voltage and harsh industrial environments. This study has been carried out at the facilities of High-Voltage Test Lab of ABB.

2.1.6 Design and Implementation of Wireless Sensor Network for Machine Condition Monitoring and Fault Diagnosis

Mr. Avadhut J. Rane, Mr. P. G. Khedkar, Department of Electronics and Telecommunication Engineering, Mumbai University.

This Paper proposes a novel industrial wireless sensor network (IWSN) for industrial machine condition monitoring and fault diagnosis. In this project, the induction motor is taken as an example of monitored industrial equipment due to its wide use in industrial processes.

2.1.7 **Development and Implementation of Wireless Sensor Network for the Electricity Substation Monitoring**

Paulo Sausen, Airam Sausen, Fabiano Salvadori, Renê Emmel Júnior and Mauricio de Campos.

The requirements for process instrumentation, combined with the advances in wireless communications and electronics allowed the design of wireless sensor networks (WSNs). The technology applied to these sensors and communication networks has enabled the evolution of these systems has been called a smart sensor networks. In this case, not only collect sensor data, but also perform local processing, and may also act in the system, and subsequently, if necessary perform transmission. These smart sensor networks allow a more effective monitoring system, fault detection, and others, thus improving the reliability and system maintenance [2, 3, 6].

III. MOTIVATION

Transformers are one of the most expensive and strategically important components of any power system, so that their proper and continuous function is important to system reliability. Ageing of the oil/paper insulation system of power transformers is influenced by thermal, electromechanical and chemical stresses. Thermal stress leads to major degradation process for both oil and cellulose paper. Under all these stresses, the paper ultimately becomes brittle and the durability against mechanical stress is

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09 – 12

strongly reduced. As a result, reduction in expected life of transformer will occur.

Hence, here is the main reason, to develop this project and make the transformers more efficient to work and have more life.

III. PROBLEM DEFINITION

Problem definition in the existing system, transformer monitoring is not at its efficient level. Hence life of transformer is going to decrease day by day due to its less maintenance.

To solve the problem of this problem, the present system is proposed. This include a WSN(wireless sensor network), a ZigBee protocol, and a CAN BUS to create an highly efficient system that can be used with high economical way and universally.

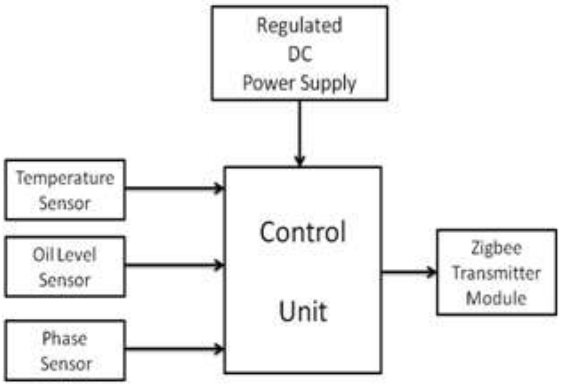
IV. OBJECTIVE

The main purpose of this system is to solve a monitoring and maintenance problem for transformers at very high level. In exit system, the monitoring is implemented using SCADA, simple short range RF modules.

But in the present system, here the monitoring of the transformer parameters is done by a ZigBee wireless protocol.

V. DESCRIPTION OF THE PROPOSED WORK

- **Transmitter Block Diagram**



FIGUR

- **Receiver Block Diagram**

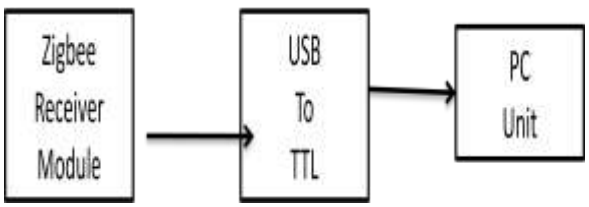


FIGURE 6.2: Receiver Block Diagram

- **Description**

The monitoring system is constituted by three major units, namely,

1. Data processing and transmitter unit
2. Load and Measurement Systems
3. Receiver and PC display unit

We have designed a system based on microcontroller (AVR) that monitors and controls the voltage, current and oil temperature of a distribution transformer present in a substation. The monitored output will be displayed on a PC at the main station that is at a remote place, through RF communication. The parameters monitored at the distribution transformer are compared with the rated values of the transformer. Additionally the breakdowns caused due to the overload and high voltage are sensed and the signals are transmitted to the main station using RF communication. The software in the PC compares the received values with the rated measurements of the distribution transformer and shuts down the transformer so that it can be prevented from damages and performances can be enhanced quiet to a remarkable level.

The controller consists of a sensing unit which collects the essential parameters such as current, voltage and the oil temperature within the distribution transformer. The digital display connected to the processing unit displays corresponding parameter values at the substation for any technical operations. The controller also senses the overload and high current flow conditions in the internal windings that may lead to breakdown of the corresponding unit. The microcontroller is programmed in such a manner so as to continuously scan the transformer and update the parameters at a particular time interval. The parameter values sensed by the microcontroller are transmitted through the RF transmitter connected to the microcontroller unit.

The transmitted signals are received at the main station using the RF receiver. The received signals are then passed to the PC. The software loaded in the PC is used to monitor the changes in the parameters that are measured from the distribution transformer. When a remarkable change is noticed in the measured values it controls the unit by ending it from any serious damages.

VI. CONCLUSION

In this paper we have presented a design of a system based on AVR microcontroller that is used to monitor and control the voltage, current and temperature of a distribution transformer. The proposed system which has been designed to monitor the transformers essential parameters continuously monitors the parameters throughout its operation. If the microcontroller recognizes any increase in the level of voltage, current or temperature values the unit has been made shutdown in order to prevent it from further

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09 – 12

damages. The system not only controls the distribution transformer in the substation by shutting it down, but also displays the values throughout the process for user‟s reference. This claims that the proposed design of the system makes the distribution transformer more robust against some key power quality issues which makes the voltage, current or temperature to peak. Hence the distribution is made more secure, reliable and efficient by means of the proposed system.

REFERENCES

[1] T.K. Saha, M. Darveniza, D.J.T. Hill, T.T. Le, "Electrical and Chemical Diagnostics of Transformer Insulation-part B: Accelerated Aged Insulation Samples" , IEEE Transactions on Power Delivery, Vol. 12, No. 4, October 1996, pp.1555–1561.

[2] A.J. Kachler, I. Hohlein, "Ageing of Cellulose at Transformer Service Temperatures. Part 1: Influence of Type of Oil and Air on the Degree of Polymerization of Pressboard, Dissolved Gases, and Furanic Compounds in Air", IEEE Electrical Insulation Magazine, Vol. 21, No. 2, March / April 2005, pp. 15–21.

[3] M.C. Lessard, L. Van Nifterik, J.F. Penneau and Robert Grob, "Thermal Ageing Study of Insulating Papers Used in Power Transformers" , Conference on Electrical Insulation and Dielectric Phenomena, San Francisco, October 20–23, 1996, pp. 854–859.

[4] M. Darveniza, D. Hill, Tri Le. T.K. Saha, "Studies of the Condition of Insulation in Aged Power Transformers Part 2: Fundamental Electrical and Chemical Consideration", 3rd International Conference on Properties and Applications of Dielectric Materials, July 8–12, 1991, Tokyo-Japan, pp. 1120–1123.

[5] M. Darveniza, D.J.T. Hill, T.T. Le, T.K. Saha, B. Williams, "Chemical Degradation of Cellulosic Insulation Paper for Power Transformers", Proceedings of the 4th International Conference on Properties and Applications of Dielectric Materials, July 3–8, 1994, Brisbane Australia, pp. 680–683.

[6] B. Garcia, J.C. Carlos Burgos, A.M. Alonso, J. Sanz, "A Moisture-in-Oil Model For Power Transformer Monitoring- Part I: Theoretical Foundation", IEEE Transactions on Power Delivery, Vol.20, No. 2, April 2005, pp. 1416–1422.

[7] S. Birlasekaran, Yu Xingzhou, "Relaxation Studies on Power Equipment", IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 10, No. 6, December 2003, pp. 1061–1066.