Remote Monitoring System For A Switchable Distribution Transformer By The Use Of Wireless ZigBee Technology

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ABSTRACT: This paper proposes a wireless ZigBee technology to monitor the parameters of the transformer. The transformer parameters such as voltage, current, power factor and temperature can be monitored through wireless ZigBee technology. Embedded Ethernet is used to develop client and server applications. Acquisition of voltages, currents, temperatures, active and reactive power, controlling the switching devices and acquired data processing can be done by an embedded system. The modules in the embedded system are connected and the images of the transmission lines of the transformer during the power transmission will be noted and compared with the standard IR images by the use of image processing to observe the level of temperature passing through the transmission lines. Active power and the reactive power of the transformer which specifies the power usage and power wastage of the transformer respectively can be monitored. MATLAB simulations are carried out for the parameter monitoring.

Keywords: Wireless ZigBee Technology, Image processing, Switchable distribution transformer, Embedded Ethernet.

I. INTRODUCTION

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network.

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ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range wireless transfer of data at relatively low rates.

ZigBee is a low cost, low power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory. Data transmission rates vary from 20 to 900 kilobits per second. The ZigBee network layer natively supports both star and tree typical networks, and generic mesh networks.

Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. ZigBee builds upon the physical layer and medium access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification goes on to complete the standard by adding four main components: network layer, application layer, ZigBee device objects and manufacturer defined application objects which allow for customization and favour total integration. Besides adding two high level network layers to the underlying structure, the most significant improvement is the introduction of ZDOs. These are responsible for a number of tasks, which include keeping of device roles, management of requests to join a network, device discovery and security.

II. LITERATURE SURVEY

Remote monitoring has been implemented in many areas and it has a specific application to a three phase 10-kVA energy-efficient switchable distribution transformer. A designed embedded system and embedded Ethernet have been implemented to achieve a compact remote condition monitoring for the transformer. The embedded system performs acquisition of voltages, currents, and temperatures, controls the switching devices that connect the tappings of the transformer, and processes acquired data. Some protocols were developed as parts of software development of the whole system. Experimentation was done by applying the remote monitoring system to the transformer connected to three-phase variable supply voltage and load.

The development of integrated, portable, transformer condition monitoring (TCM) equipment for classroom demonstrations as well as for student exercises conducted in the field is discussed. Demonstrations include experimentation with real-world transformers to illustrate concepts such as polarization and depolarization current through oil-paper composite insulation. The developed equipment has also been used to understand and illustrate the phenomenon of recovery voltage. Finally, the portability and robustness of the equipment enables students to collect data from transformers installed on-site for the purpose of validating the nature of curves obtained in real-world environments.

There are plenty of proper monitoring methods to evaluate the condition and possible incipient failures of a power transformer. For distribution transformer monitoring, the methods are usually too expensive and/or time consuming to use. However, cost-efficient methods for distribution transformer monitoring are needed and one possibility for this is to utilize loading and temperature information measured from the network. The monitoring methods are based on the existing IEC and IEEE standards and neural-network analysis. The methods are used to calculate the top-oil and hot-spot temperature as well as the loss of life of a transformer.

We describe a recently developed DC motor position control experimental setup that can be accessed via the Internet. This setup consists of two primary elements communicating with each other: i) a server consisting of a low-cost microcontroller, Parallax's 40-pin Basic Stamp 2, interfaced with an embedded Ethernet IC, Cirrus Logic's Crystal CS8900A, and ii) a client computer. The client computer sends/receives data to/from the microcontroller using the user datagram protocol packets. The client computer connects to the server using Java applets that allow the user to command the position of the motor via a graphical user interface.

III. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In the existing system the parameters of the transformer were monitored and the modules of the embedded system were connected and communicated through the CAN bus which is wired communication. Wired communication has some drawbacks when they carry data such as loss of data and lack of effective communication. Another thing in this system is the parameters of the transformer such as voltage current temperature and power factor were measured but active power and the reactive power was not measured.

Drawbacks

1. Since the communication is wired there will be considerable power loss and also data loss. Efficient data transmission is so much important in transformer monitoring. But there will be loss of data in the CAN bus.
2. Active power and reactive power was not measured. By the use of active and reactive power measurement we can analyze the level of temperature passing on the transmission lines.

a. *PROPOSED SYSTEM*

In the proposed system the transformer parameters such as voltage current and temperature can be monitored through wireless technology. The modules in the embedded system are connected through wireless ZigBee technology and the images of transformers during the power transmission will be noted and compared with the standard IR images by the use of image processing.

Active power and the reactive power of the transformer can be monitored. The monitored parameters will be given to the microcontroller and also the images will be sent to the embedded Ethernet which consists of microcontroller and acts as server and client.

3.2.1 ADVANTAGES

1. No wires involved in the proposed system. Hence we can avoid power and data loss. It can able to detect the faults due to over current, under voltage, increased temperature.
2. It can be operated in any environment in a Transformer. Monitoring multiple transformers sitting in an office is possible.

IV. SYSTEM DESCRIPTION

4.1 Transformer Module

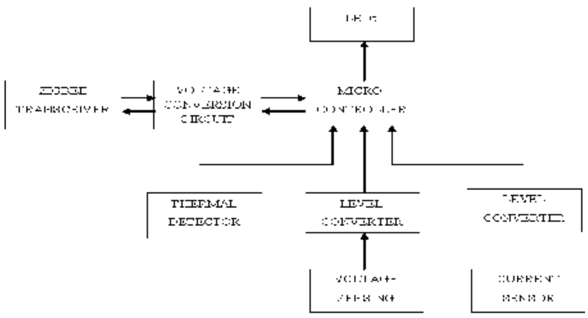

Fig 4.1: Block Diagram for transformer Module

4.2 Control Room Module

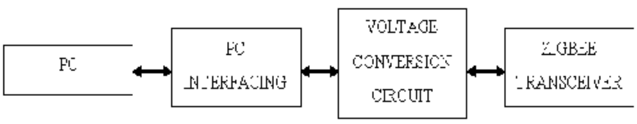

Fig 4.2: Block Diagram for Control Room Module

4.3 Transformer Monitoring

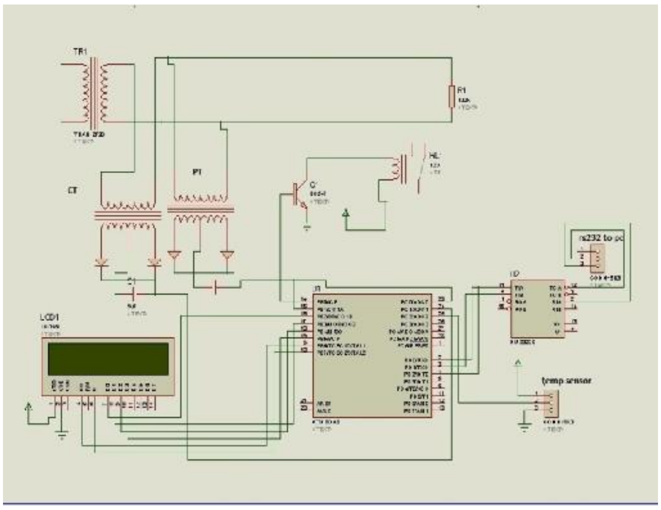

Fig 4.3 Transformer Monitoring

V. CONCLUSION

Remote monitoring of systems has been increased today. Monitoring the transformer parameters such as current voltage temperature and power factor by the use of ZigBee technology is implemented.

The temperature passing on the transmission lines will be monitored and compared with the IR images by the help of image processing which provides the condition of the transmission lines and the level of the temperature passing through it. Additional parameters such as active and reactive power is measured to monitor the parameters effectively and to provide the proper precautions.

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