“Supervisory Model for Predictive Transformer Protection And Maintenance Using Wireless Sensor Network”

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ABSTRACT-

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. This paper presents design and implementation of a system to monitor and record key operation of a distribution transformer like overvoltage, over current, temperatures, rise or fall of oil level. This based on Wireless protocol. Sensors, including a Temperature Detector and a Liquid level sensor performs according to manufacturers’ specifications are calibrated and tested By power distribution monitoring offices. The system is installed at the distribution transformer site and by measuring above parameters it will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure.

Keyword : Distribution transformer, Wireless protocol.

1. INTRODUCTION:

On line Wireless monitoring and diagnostic of power transformers has attracted considerable attention for many years. The main objectives are to prevent forced outages, indicate acceptable overload, assess the remaining insulation-life and reduce maintenance costs. To achieve these goals, the monitoring system manufacturers must follow strategies, which are in line with the interests of transformer owners. Transformer is the key equipment in power system, to ensure its safe and stable operation is important. Transformers either raise a voltage to decrease losses, or decreases voltage to a safe level. "Monitoring” is here defined as on-line collection of data and includes sensor development, measurement techniques for on-line applications. It is very difficult and expensive to construct the communication wires to monitor and control each distribution transformer station. Here Zigbee is used for communicating the monitored parameters.
The failures of transformers in service are broadly due to: Over Load condition temperature rise, low oil levels, over load, Earth grounding, and improper installation and maintenance. Out of these factors temperature rise, low oil levels and over load, need continuous monitoring to save transformer life. A distributed transformer networks remote monitoring system increases the reliability of distribution network, by monitoring critical information such as oil temperature, and oil level of transformer. Data are collected continuously. Monitoring the transformers for problems before they occur can prevent faults that are costly to fix and result in a loss of service life.

2. PROPOSED TECHNOLOGY

The proposed methodology is based on Robust technology meets safety reliability and fastest in operation. It consists of a sensing system, signal conditioning electronic circuit, controller. It is installed at the transformer site and the finding parameters recorded using the analog to digital converter of the embedded system. The acquired parameters are processed and recorded in the system memory. system will help the system to run under reliable condition and identify problems before any failure. For above result we are using a small step down transformer of 12 V, 1 Amps rating and small bulb are connected as a load. In this project we are using CT transformer for measuring load current. Also we are using Temp. Temperature Sensor for giving any rise of temperature, oil level sensor is also used which detects any fall of oil level. The values of voltage, current and temperature and level of oil of the transformer is directly applied to one of the input ports of the microcontroller. Along with this, a display is connected in the input port of the microcontroller value then the transformer will automatically shut down and in this way transformer life will be increased. We also designed Two-way communication here by which we can ask system about given parameter value just by sending Wireless Data to it so that we can have watch over transformer. For this it is not necessary for the operator to sit in the system premises which was the case at conventional system.

3. BLOCK DIAGRAM

![Block Diagram of transformer section](image-url)
4. CIRCUIT DIAGRAM:

Variable regulator IC LM317: The LM317 is an adjustable 3–terminal positive voltage regulator capable of supplying in excess of 1.5 A over an output voltage range of 1.2 V to 37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow−out proof.

A. Main Circuit ATMEGA16:

Fig 3. Sensor Interfacing

Fig 4. Interface sensor with zigbee
The ZIGBEE interface is another part of the transmitter section. The pin 3 (data in) of ZIGBEE module is connected to the USART transmission (TX-25) pin of port C in PIC. This wireless transmission follows USART protocols and is according to IEEE 802.15.4. ZIGBEE is a transceiver, in the transmitter section it is used as the transmitter. The receiver address of this ZIGBEE module is set as the address of the ZIGBEE module in the main server, so that data is send to this receiver only. It is a low power, low cost wireless mesh networking standard and it uses the ISM band for its transmission.

The Controller requires oscillator for clock generation, for this a crystal oscillator 16 MHZ is connected between pin 13 & 14. Parasitic capacitor of 33pf is used to increase the stability of the oscillator.

In pin 1 of the PIC a switch is connected for resetting the registers. Pin 1 is the master clear. During normal operation its value is high, when the switch is pressed all the registers of the PIC is cleared.

The supply to the PIC (5V) is given by the supply circuitry given in fig 4.1. The supply is given to pin 11of the PIC. The supply to ZIGBEE module (3.3V) is given by LM317, which is given to pin 1 of ZIGBEE.

![Fig.5 Oil Level Circuit](image)

**A. Transistors Relay Load Control And Cooling System Control:**

Then the transistor operates as a "single-pole single-throw" (SPST) solid state switch. With a zero signal applied to the Base of the transistor it turns "OFF" acting like an open switch and zero collector current flows. With a positive signal applied to the Base of the transistor it turns "ON" acting like a closed switch and maximum circuit current flows through the device. An example of an NPN Transistor as a switch being used to operate a relay is given below. With inductive loads such as relays or solenoids a flywheel diode is placed across the load to dissipate the back EMF generated by the inductive load when the transistor switches "OFF" and so protect the transistor from damage. If the load is of a very high current or voltage nature, such as motors, heaters etc, then the load current can be controlled via a suitable relay as shown.

The circuit comprises sensor parts built using op-amp IC LM324. Op-amps are configured here as a comparator. There sensitivity can be changed with the help of variable resistor. Level sensor wires are inserted in the Transformer to sense the Oil level of the transformer. The voltage from the copper plats are feed to comparator operational amplifier LM324 to compare with know voltage, then as result we get logic output either false (logic zero "0" or 0v) or true (logic one "1" or 5v) depending upon the copper sensing voltages from level sensing apparatus.

Output form LM324 is fed to microcontroller to transmit data over receiver section via zigbee module. The aim is to design an ambient temperature measurement circuit. The motivation for doing this Circuit is the
fact that temperature measurement of Transformer has become an integral part of any control system operating in a temperature sensitive environment.

A. PC Interfacing Circuit Receiver section:

In the receiver section the ZIGBEE module can be used as receiver. This module receives the data send by the transmitters. The supply to the ZIGBEE module (3.3V) is given by the supply circuitry in fig with LM317. To interface with the computer we have to convert the TTL logic into RS232 logic, for this purpose we use the IC MAX232. MAX232 is a dual driver/receiver that includes a capacitive voltage generator. The drivers (T1 & T2), also called transmitters, convert the TTL/CMOS logic input level into RS232 level. The transmitter (pin 10-T2 in) take input from ZIGBEE’s data out pin (pin 2 of ZIGBEE) and send the output to RS232’s receiver at pin 7 (T2 out) of MAX232. We use four capacitors, two for doubling the voltage and other two for inverting the voltage. The capacitors are connected between pin 1 and pin 3, pin 4 and pin5, pin 2 and VCC, and pin 6 and GND. The transmitter output (T2 out) from MAX232 (RS232 logic) is connected to pin 2 (receive data) of RS232 port. Thus the data received are given to PC. The pin 5 of RS232 port is connected to ground.

A. Wireless Sensor Network:
This project used in Zigbee wireless sensor for communication between distributed transformer section and office monitoring section.

The Zigbee XBee Module 2mW PCB Antenna - Series 2 (ZigBee Mesh) allows a very reliable and simple communication between microcontrollers, computers, systems, really anything with a serial port. Point to point and multi-point networks are supported. These are essentially the same hardware as the older Series 2.5, but have updated firmware. They will work with Series 2.5 modules if you update the firmware through X-CTU. The modules require minimal power and provide reliable delivery of data between remote devices.

ZigBee is a specification for a suite of high level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15 standard. Though low-powered, ZigBee devices often transmit data over longer distances by passing data through intermediate devices to reach more distant ones, creating a mesh network; i.e., a network with no centralized control or high-power transmitter/receiver able to reach all of the networked devices. The decentralized nature of such wireless ad hoc networks make them suitable for applications where a central node can't be relied upon.

ZigBee is used in applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/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. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth or Wi-Fi.

Fig. 9 Supervisory Model for Transformer

5. SIMULATION RESULTS

Fig 10. Monitoring System
A. Comparative Result Analysis:
With continuous analysis over a period of days, with the help of the daily status reports, the loading condition of the transformer can be accurately established, and depending on the results, necessary steps can be taken. In comparison to the peak load analysis method that is being used by the distribution company to analyses transformers, this system offers a much improved solution as transformer loading is analysed over time before a solution is reached. In case of any abnormal conditions or persistent overload, the authority can put the transformer out of service before any catastrophic failure happens. The system also offers potential for further transformer condition analysis such as loss of life determination through insulation aging calculations.
Load Guide for oil mineral immersed transformers, transformer monitoring requires assessment of the transformer remaining service life. Analysis of transformer remaining service life requires probabilistic computations using present data gathered from the transformer condition monitor and previous monitoring history. A conclusion can be drawn with regard to time of transformer failure estimate. With this kind of information, the distribution companies can plan to a great level of certainty how long it will take before their assets in the field need replacement and would further guide proper planned maintenance.

6. CONCLUSION:
With modern technology it is possible to monitor a large number of parameters of distributed transformer at a relatively high cost. The challenge is to balance the functions of the monitoring system and its cost and reliability. In order to get effective transformer monitoring system to a moderate cost, it is necessary to focus on a few key parameters. WDTMS is able to record and send abnormal parameters of a transformer to concerned office. It works on Wireless technology.
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