International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, February 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Wireless Automated Transmission System For Guarding or Health Monitoring Of High Voltage Transformer

Mr. V. B. Patil[1],Patil Pooja[2], Patil Dhanashree[3], More Tejaswini[4], Ghewari Vinayak[5], Patil Shailesh[6], Surve Amol[7]

[1,2,3,4,5,6,7]*(Assistant Professor Department of EE , Vathar, Kolhapur.)*

ABSTRACT

High voltage power transformer is extensively operated in the generation of electrical energy in either voltage stepping up or stepping down condition. The additional attachments namely breather, cooling fan, bushing, differential relay, Buchholz relay are synchronized with the transformer operation. It is essential to estimate the troubles occurring in it and to expound them as soon as desirable, so the high cost transformer does not get destructed and also helps in maximum use of it. Here it targets how to decrease and determine them in effective way. In this paper a tryout has been made of detailed use of system and wireless automated transmission system for guarding and ideal use of High voltage transformer.

This project is about design and implementation of Arduino to monitor and record key parameters of a distribution transformer like currents, oil level and ambient temperature. The idea of monitoring system integrates a Global Service Mobile (GSM) Modem, with a standalone Arduino and different sensors. It is installed at the distribution transformer site and the above parameters are recorded using the analog to digital converter (ADC) of the embedded system. The obtained parameters are processed and recorded in the system memory. This mobile system will help the transformers to operate smoothly and identify problems before any catastrophic failure.

Keywords-ARDUINO ATmega328, sensors.

I.INTRODUCTION

In power systems, distribution transformer is electrical equipment which distributes power to the low – voltage users directly, and its operation condition is an important component of the entire distribution network operation. Operation of distribution transformer under rated condition guarantees their long life .However their life is significantly reduced if they are subjected to overloading, 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. The monitoring devices or systems which are presently used for monitoring distribution transformers have some problems and deficiencies. Few of them are mentioned below:

1) Ordinary transformer measurement system generally detects a single transformer parameter, such as power, current, voltage. While some ways could detect multi- parameter, the time of acquisition and operation parameters is too long, and testing speed is not fast enough.

2) Detection system itself is not reliable. The main performance is the device itself instability, poor anti jamming capability, low measurement accuracy of the data, or even state monitoring system should is no effect. Many monitoring systems use power carrier communication to send data, but the power carrier communication has some disadvantages: serious frequency interference, with the increase in distance the signal attenuation serious, load changes brought about large electrical noise. So if use power carrier communication to send data, the real-time data transmission, reliability cannot be guaranteed. According to the above requirements, we need a distribution transformer real-time monitoring system to detect all operating parameters operation, and send to the monitoring centre in time. It leads to online monitoring of key operational parameters of distribution transformers which can provide useful information about the health of transformers which will help the utilities to optimally use their transformers and keep the asset in operation for a longer period. This will help to identify problems before any serious failure which leads to a significant cost savings and greater reliability. Widespread use of mobile networks and GSM devices such GSM modems and their decreasing costs have made them an attractive option not only for voice media but also for other wide area network application.

II.SYSTEM LAYOUT

The proposed block diagram has shown in fig 1 shows the entire system layout. The main transformer is the high voltage transformer that has to be protected. There are four parameters present i.e. voltage, current, gas & temperature for the monitoring purpose in the system. The CT (current transformer) is used to calibrate the current value coming from the supply and send it to the Arduino. The PT (potential transformer) is used to calibrate the voltage value coming from the supply and send to the Arduino. During fault condition in voltage and current the signal from the PLC is sent to the relay and the main transformer is disconnected. Gas sensor is provided to detect the gas produced in the main transformer. Generation of gas inside the transformer is a big issue which is developed due to atomization of oil, corona, overheating, arcing in the transformer, etc; all this transformation of instruction will be constantly monitored by the gas sensor and signal sent to the PLC and exhaust fan will be switched on. The part of the scheme complication clears away the heat in larger transformers. If under any prospects temperature increases above the particular level which consequently will alert the transformer performance. The temperature sensor gives the data to the Arduino and the suitable operation is carried out according to the requirement such as cooling fan

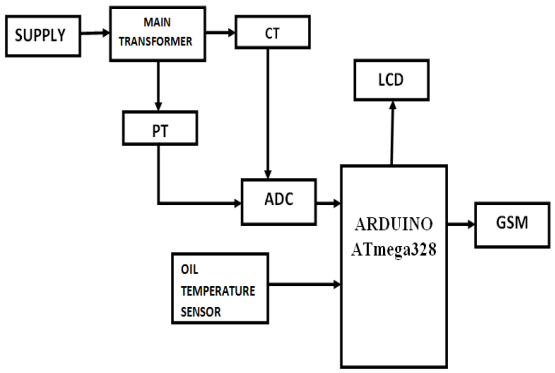

Figure 1: Block Diagram

A. Transformer Fault Analysis

A power transformer consists of a set of windings around a magnetic core. The windings are insulated from each other and the core. Operational stresses can cause failure of the transformer winding, insulation, and core. The power transformer windings and magnetic core are subject to a number of different forces during operation:

1. Expansion and contraction caused by thermal cycling
2. Vibration caused by flux in the core changing direction
3. Localized heating caused by eddy currents in parts of the winding, induced by magnetic flux
4. Impact forces caused by fault currents.
5. Thermal heating caused by overloading.

These operating limits only considered the thermal effects of transformer overload. Later, the capability limit was changed to include the mechanical effect of higher fault currents through the transformer. Power transformer faults produce physical forces that cause insulation wear. These effects are cumulative and should be considered over the life of the transformer.

The following discussion highlights on different capability limits of transformer.

B. Over Load:-

Over Load Over current is the current flowing through the transformer resulting from faults on the power system. Fault currents that do not include ground are generally in excess of four times full-load current; fault currents that include ground can be below the full-load current depending on the system grounding method. Overload, by contrast, is current drawn by load, a load current in excess of the transformer nameplate rating. In summary, loading large power transformers beyond nameplate ratings can result in reduced dielectric integrity,

thermal runaway condition (extreme case) of the contacts of the tap changer, and reduced mechanical strength in insulation of conductors and the transformer structure.

C. Temperature:-

Excessive load current alone may not result in damage to the transformer if the absolute temperature of the windings and transformer oil remains within specified limits. Transformer ratings are based on a 24-hour average ambient temperature of 30°C (86°F). Due to over voltage and over current, temperature of oil increases which causes failure of insulation of transformer winding.

D. Over/Under Voltage:-

The flux in the transformer core is directly proportional to the applied voltage and inversely proportional to the frequency. Over voltage can occur when the per-unit ratio of voltage to frequency (Volts/Hz) exceeds 1.05 p .u at full load and 1.10 p .u. at no load. An increase in transformer terminal voltage or a decrease in frequency will result in an increase in the flux. Over excitation results in excess flux, which causes transformer heating and increases exciting current, noise, and vibration.

E. Oil Level Fault:-

Oil mainly used in transformer for two purposes one is for cooling of transformer and another use is for insulation purpose. When temperature of transformer goes high, oil level in transformer tank decreases due to heating effect. For normal operation of transformer oil level should maintain at required level. If oil level decreases beyond required level, it affect cooling and insulation of the transformer.

F. The ARDUINO ATmega328

The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC(Complex Instruction set computing) microcontrollers. The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM (Electrically erasable programmable read-only memory), 2Kbytes SRAM (Static Random Access Memory), 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs(Universal Synchronous and Asynchronous Receiver-Transmitter), 1 byte-oriented 2-wire Serial Interface (I2C), a 6- channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI (Serial Peripheral Interface) serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM (Static Random Access Memory), Timer/Counters, (Serial Peripheral Interface) SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer

continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run.

Atmel offers the Q Touch library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully denounced reporting of touch keys and includes Adjacent Key Suppression (AKS™) technology for unambiguous detection of key events. The easy-to-use Q Touch Suite tool chain allows you to explore, develop and debug your own touch applications.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP (Image Signal Processor) Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core.

The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC (Reduced Instruction Set Computer) CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega328/P is supported with a full suite of program and system development tools including: Compilers, Macro Assemblers, and Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

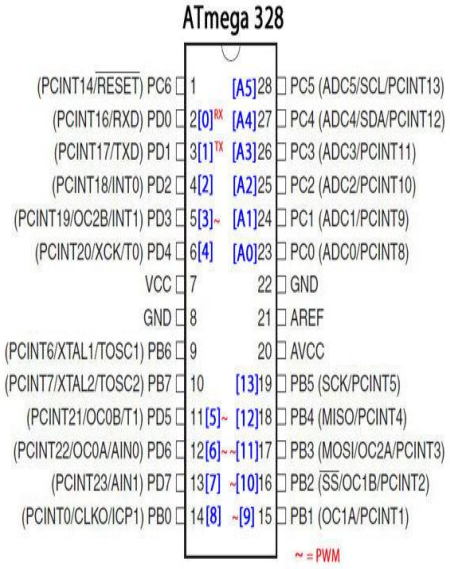

Figure 2: Pin diagram

a) Current and Voltage Transformer:

Current Transformer or potential transformers are necessary for isolating the protection & control. The behavior of current and voltage transformer during and after the occurrence of fault is critical in electrical protection since error in signal

b) Temperature Sensors LM35:

LM35 can measure temperature more accurately than a using a thermistor. The sensor circuitry is impenetrable and not subject to rust, etc. The LM35 generates output voltage from transformer can cause mal operation of the relays.

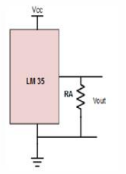

Fig. 3. Wired LM 35

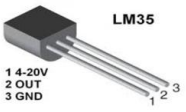

Fig. 4.: Temperature Sensor LM35

a) Gas Sensor

Gas sensor is useful for gas leakage detection. It is suitable for detecting H_2, LPG, CH_4 CO, Smoke or Propane. Due to its high sensitivity and fast response time measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Figure 2: Gas Sensor

I. SIMULATION

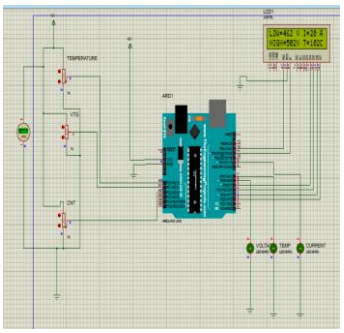

Figure 5: Circuit diagram

1. Voltage Output :

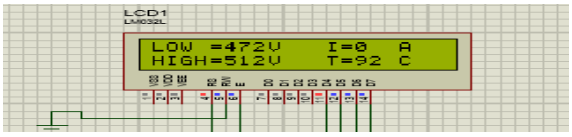

Figure 6: Voltage Output

In this parameter we set threshold value of voltage is 500V and we set difference between high voltage and low voltage is 40V. If fault occurs or any problem occurs then set value changed which is monitoring the ARDUINO and notification given to the operator who is connected to GSM modem.

2. Temperature Output :

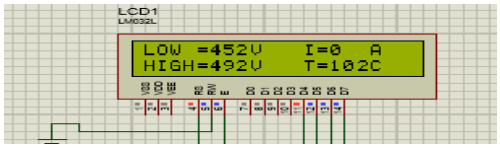

Figure 7: Temperature Output

In this parameter we set threshold value of temperature is 100 ℃.If fault occurs or any problem occurs then set value changed which is monitor the ARDUINO and notification given to the operator who is connected to GSM modem.

3. Current Output :

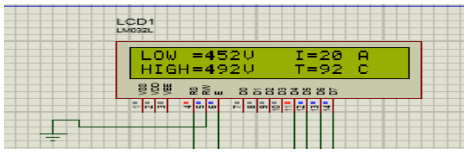

Figure 8: Current Output

In this parameter we set threshold value of current is 10A .If fault occurs or any problem occurs then set value changed which is monitor the ARDUINO and notification given to the operator who is connected to GSM modem.

III.CONCLUSION

Transformers are among the most generic and expensive piece of equipment of the transmission and distribution system. Regular monitoring health condition of transformer not only is economical also adds to increased reliability. With the advancement of communication technology now it is possible to receive fault information of transformer through GSM technology.

During abnormal conditions exceeding specified limits information is immediately communicated through GSM technology to the operator and also to concerned authority for possible remedial action also increases mean down time of transformer there by increased reliability and decreased cost of power system operations.

REFERENCE

[1] Mudhafar A. AI-Nema, Sinan M. Bashi, And Abdulhadi A. Ubaid," Microprocessor-Based Over current Relays", IEEE Transactions On Industrial Electronics, Vol. Ie-33, No. 1, February 1986

[2] S. Dharanya, M. Priyanka, R.Rubini and A.Umamakeswari "Real time Monitoring and Controlling of Transformers"Journal of Artificial Intelligence, ISSN 1994-5450,2012.

[3] Yusuf Amrulloh, UdanthaAbeyratne, ChandimaEkanayake,

"Gas and Optical Sensing Technology for the Field Assessment of Transformer Oil" International Journal of Emerging Electric Power Systems Volume II, Issue 4 2010

[4] D. L. Ayers, D. White, T. Wright" Development of a Low Noise FOA Transformer Cooler Part I: Fan and Heat Exchanger Design" R. C. Settembrini, Member, IEEE

[5] Cao, J., S. Qian, H. Hu and S. Yang, 2008. Wireless monitoring and analyzing system of dissolved gases in the transformer oil. Proceedings of the 7th World Congress on Intelligent Control and Automation, June 25-27, 2008, China, pp: 5152-5157.

[6] Girish R. Kamath" An Electrical Circuit based 3-D Steady State Thermal model of a Fan Cooled 60 Hz, 20 kW 3-Phase Plasma Cutting Power Supply Transformer" 01972618/07/$25.00 © 2007 IEEE