

Article

Condition Monitoring of Distribution Transformer using Internet of Things (IoT)

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A B S T R A C T

Transformers are utilized for electricity distribution and transmission which decreases the main voltage to the use voltage for customer. As distribution transformers are very higher in electrical manufacturing consequently this article offerings the system which monitor dissimilar parameters of distribution transformer. There are double units which are Remote Terminal Unit (RTU) and monitoring unit. Remote terminal unit contain of examining parameters such as current, temperature, rise and fall in oil level, vibration and humidity with the assistance of PIC 18F4550. All monitoring limitations are handled and if any irregularity happens, the system sends Alert communications to the mobile phones and recorded in system memory finished (ADC) Analog to Digital Converter. All parameters values are sent to monitoring node through GPRS. If any emergency condition occurs immediately message send to the consistent engineer through GSM and likewise on webpage we can get alert about it finished GPRS. Near remote terminal unit buzzer will beep and LCD stretches announcement about emergency condition. An engineer at transformer cannot uninterruptedly keep an eye on transformer therefore given planned system does communication with us at emergency conditions of distribution transformer finished GSM/ GPRS module.

Keywords: Distribution Transformer, PIC Microcontroller, GSM/ GPRS Module, Current, Temperature, Oil Level, Vibration, Humidity, Remote Terminal Unit (RTU), Monitoring Unit

Introduction

The foremost backbone for any power distribution network is distribution transformer. In this article we are emerging on-line monitoring system which has numerous compensations such as info assembly, healthier management, condition assessment and decision manufacture for engineers.² Main function of distribution transformer is to convert high AC voltage to low.

Lifetime of distribution transformer is in essential of on the rated conditions. If transformer is employed with normal conditions then it has long life and becomes less if they are

overloaded. Overloading of distribution transformer reduces system reliability.^{9,10} Now days, Distribution transformers are monitored manually for maintenance and recording parameter values. There are some faults in manual testing which are produced by oil and windings. This planned system incapacitates all difficulties of manual testing and advances life of transformer. Graphical picture of all the limits give complete idea of employed of transformer to engineer.

Technique of GPRS

GPRS has full form as over-all packet radio service. This skill

is a packet-switching skill which handovers data through cellular networks. This skill used by data communications, mobile internet, MMS. Speed of GPRS is 115 kbps and it is also termed as 2.5G. The GPRS and GSM parameters of the system operate distinctly. The GSM & GPRS skill is used for voice calls, while GPRS data results voice and data can be sent and received instantaneously. Services provided by GPRS & Internet are same means GPRS and internet are analogues to each other. Mobility, nearness and localization are characteristics of GPRS.¹

Literature Review

Buyung Sofiar to Munir supervised only vibrations of transformer with two methods which are Fast Fourier Transform (FFT) and Hilbert Huang Transform (HHT) for finding discrete fourier transform and converting vibration signal into small intrinsic mode functions respectively.³ Second way for monitoring health of transformer is widespread technique that is Neural network. This technique gives relation between gases in transformer oil which are dissolved and improve reliability and accuracy of health of transformer.⁴ D S Suresh have used PLC and SCADA system for monitoring of transformer and GSM technique for sending parameters values and emergency condition through SMS.⁵⁻¹² From the directly above review, it is in conclusion decided that there are some faults in above systems but by using planned Microcontroller based method we can improve it to healthier extend. Given planned system monitor all the major parameters and display it on webpage having network IP address 172.16.3.57 with GPRS technique with SMS alert using GSM.

Overall System Design

The System Design Consists of Twoparts:

Hardware Design

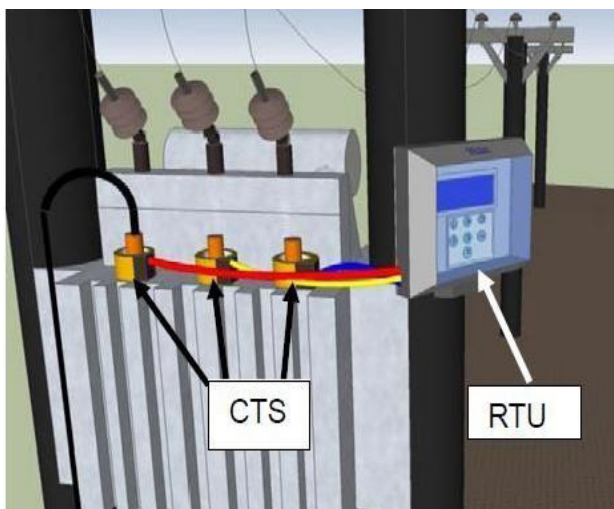


Figure 1. System Architecture of An Intelligent stick using iBeacon technology

Figure 1, illustrate Distribution transformer condition intensive care hardware setup of computer aided design by means of 3D modeling. PIC 18F4550 Microcontroller with dissimilar sensors such as current sensor, temperature sensor, oil level sensor, vibration sensor, humidity sensor comes in hardware design as input devices at Remote Terminal Unit (RTU).⁶ After accomplishment all constraint values from microcontroller are demonstrated on liquid crystal display and likewise on web page.

GSM/GPRS module directs all parameter values to webpage as online boundary to engineers. If any emergency condition occurs like overvoltage, overcurrent, rise and fall of oil level, amplified temperature range, abnormality in vibrations and change in humidity moves the transformer life, so we are informing engineers by charitable notification by SMS finished GSM, as well as displaying on LCD with buzzer sound at Remote Terminal Unit (RTU).¹⁵ At monitoring node whole system can be accessed by webpage. The planned system is deliberated underneath:

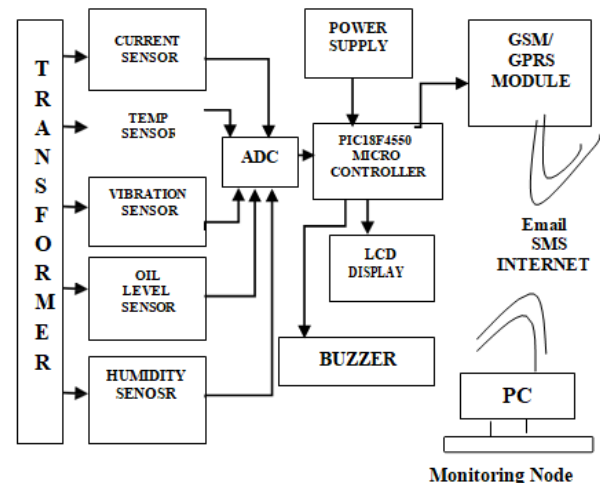


Figure 2. Block diagram of distribution transformer monitoring system

Brief introduction about components is given below.

Temperature Sensor

LM35 events temperature of windings for distribution transformer. As temperature sensor is integrated circuit sensor which stretches analog output.¹⁴ Voltage growths when temperature rises. Really, sensor records any voltage drop between the transistor base and emitter. This voltage is then amplified and gives correspondent signal that is proportional to the temperature.

Oil Level Sensor

In given planned system we are insertion oil level sensor at the tank of transformer. Level of oil is restrained with float. Float tells us the oil level and consequently we get analog output voltage.⁷ This output voltage has given to ADC of microcontroller.

Current Measuring Circuit

Current of the transformer is intended by ratio of current of primary winding to secondary winding. In this project the CT with output 5 Ampere has been preferred with ratio 1000:5. There are numbers of devoted current IC's exist which translate the current sensed into a voltage directly appropriate for the analog input of the PIC18f4550. Current sensor is used here is ACS712, 5 Ampere. According to datasheet of ACS712, 5 A the sensitivity is 185mV/A. The ACS712 produces an output of 2.5V for 0A current finished the current sensor.¹³

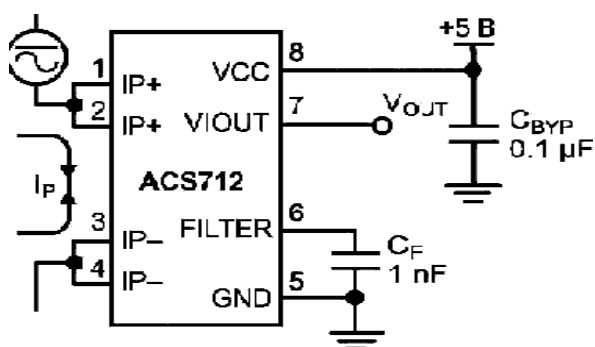


Figure 3.ACS712 IC with basic connections

Humidity Sensor

Relative humidity is detected by humidity sensor, resourcesitevents both air temperature and moisture. Relative humidity is measured in percentage, which is the ratio of moisture present time to the total quantity of moisture present in air, at that temperature can grip. It works on the basis of changes in temperature or altering electrical currents in air.

Vibration Sensor

Displacement, velocity and acceleration are three parameters are utilized for recognition of vibrations. Vibration switch SW-420 is utilized for discovery of vibrations with LM393 comparator. Beforehand Vibration switch is measured as vibration sensor as it has high sensitivity.

GSM/ GPRS Module



Figure 4.GSM/GPRS Module

SIM808 has GSM and GPRS both functions therefore it sends message as well as uses mobile data for communication. GSM sends message or SMS but we have to insert SIM

card from wireless carrier into GSM/GPRS module¹¹ After inserting SIM card we can control module by sending instructions which are AT commands. AT command such as+CMGS, +CMSS, +CMGW, +CMGD, +CMGC, +CMMS are used for sending message, sending message from storing, writing message to memory, deleting messages, sending command andextra messages to send respectively.⁸ GPRS does connection to TCP/IP protocol. GSM/GPRS module is first interface with RS-232 cable. GPRS connects to internet with HTTP. The module accessed with AT commands through TCP/IP stack[1]. For low bandwidth networks it becomes handy for data logging. GPRS also uses AT commands such asAT+CGATT=1,AT+CGDCONT=1,"IP","CMNET",AT+E2I PA=1,ATD*99***1# return CONNECT and many more.

Software Design

The software is accountable for management the PIC microcontroller & devices are associated to it.

Database Management

Database for transformer is created due to two reasons:

- If engineer needs to refer previous data which is stored at database of transformer then he can get the idea around transformer condition.
- Engineer cannot unceasingly keep an eye on transformer conditions therefore previous data is stored in database as data is updated periodically on webpage.

The database was related with monitoring node using MySQL connector for data storage and update. Database software is intended using MySQL C# programming language and Microsoft visual studio with MySQL database.⁶

Application Development

Present days universally internet is used and fetching a communication network to people. We stand captivating private IP address 172.16.3.57 and displaying webpage using GPRS. Consequently, in given planned system we are manufacture communication between transformer and people through webpage. For design of web page there are dissimilar languages can be used. All web pages that we visualize on the Internet use HTML to format its pages for display in a web browser. In given planned system, HTML language is hand-me-down to create web page. Hyper text Markup Language gives content structure and meaning which defines content as, for example, Cascading Style Sheets, headings, paragraphs. Fundamentals, tags, and attributes are three common HTML terms. Fundamentals define the content and structure of objects within a page. Tag is defined as elements surrounded by less than and greater than brackets. Additional information about an element is provided by properties called as Attributes. There are three types of ID attributes. They are class, src and href attributes which specifies an element, for embeddable

content and a linked resource of hyperlink reference. HTML page generated first in text document and then it is saved by html extension. Structure of HTML requires a defined format and they include tags such as <!DOCTYPE html>, <html>, <head> and <body>, <!DOCTYPE html> for specifying version of HTML. <head> inside <html> identifies the top of the document, including any metadata. All the content or information comes in <body>. Figure 5. shows webpage for assumed planned system.

Algorithm of Planned system

- Start
- Initialize planned system with button switch.
- All sensors such as current sensor, temperature sensor, oil level sensor, vibration sensor and humidity sensor take the reading from the transformer.
- All analog values are sent to ADC to convert them into digital.
- Digital values are passed to PIC 18F4550 microcontroller.
- PIC 18F4550 display these values on LCD.
- Microcontroller sends these values on webpage having 172.16.3.57 IP address.
- If any emergency condition occurs then immediately SMS is sent to engineers present over there through GSM.
- Buzzer beeps for indication at RTU side.
- Webpage Valued box will blow red to alert online.
- All the data values are saved in data base periodically.
- End.

Tests & Result

Afterward testing of planned system, it make available subsequent results:

- Current > 10A = Current Fault
- Temperature > 400c = temperature fault
- Oil Level < 30 ML = Oil Level fault
- Vibration > Normal Transformer Vibrations = Vibration Fault
- Humidity > 25% = Humidity Fault

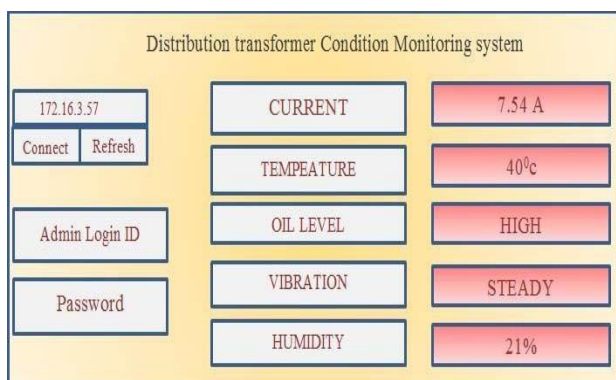


Figure 5. Distribution transformer condition monitoring system displaying on webpage

Consequently, any irregularity condition happened in above rated condition, this change shown in the LCD at RTU side, also same data monitored at one-to-one care node sent via GSM/GPRS system on webpage. All directly above results for standard conditions of parameters are demonstrated on webpage which is shown in below Figure 5.

If irregularity circumstances happen then mechanically values box for specific condition will glow red for showing alert. Figure 6 shows graphical depiction for oil level of transformer.

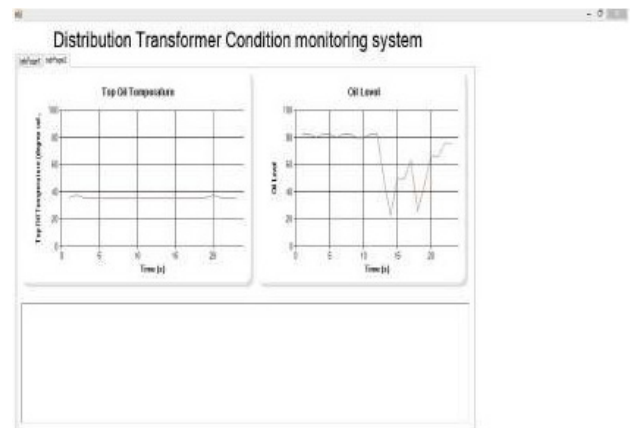


Figure 6. Graphical representation for oil level of transformer

Correspondingly, we can see graphical representation of current, temperature, vibration and humidity on webpage. Therefore, planned system is beneficial to engineers and we can prevent transformer from faults.

Conclusion

All disadvantages of manual monitoring of distribution transformer are overcome by given planned system. Main disadvantages of manual monitoring such as overheating and overloading are prevented through given system. This system designed with GSM/GPRS module and PIC 18F4550 microcontroller. GPRS is used for online monitoring of parameters of distribution transformer which can also be used in rural areas. There are four ways which are used in the planned system to alert about emergency conditions to the engineers so we can increase the life of transformer.

Future Work

In upcoming work, we can progress record of all parameters of distribution transformer which are positioned at dissimilar places. We can change to all info by employing the planned system components at each transformer. We could direct the data complete Wifi module and whole Ethernet shield. With Ethernet shield we could create remote terminal unit as a server and store data on webpage or website. Wifi module connect to nearby network and direct info to monitoring node.

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