

## Remote Monitoring of Transformer

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**ABSTRACT:** Temperature is one of the prime factors that affect a transformers life. Increased temperature is the major cause of reduced transformer life and insulation failure. So, this paper presents an IOT embedded system using microcontroller and temperature sensors to monitor transformer parameters like Oil and Winding temperature remotely. The proposed system will operate high temperature alarm using buzzer at a predetermined value of allowable temperature limit and these real time data will be transferred remotely over a Wi-Fi module to the Mobile screen/PC which is located at the substation .So, Health monitoring of transformer will help to improve the service lifetime of transformer and will detect unexpected situations before any serious failure which will definitely result in significant cost savings and greater reliability.

**Keywords-** Distribution Transformer, Oil Level, Transformer health monitoring, Temperature Sensors, Wi-Fi module,IOT.

### 1.OBJECTIVE

Online monitoring the performance of the various components i.e. oil temperature and winding temperature of the distribution transformer so as to reduce the occurrence of fault related to the transformer.

### 2. INTRODUCTION

Transformers are the utmost important equipment of power systems.If the health of the transformer will be better ,longer will be the life of transformer.In many power companies, they are using supervisory control and data acquisition (SCADA) system for monitoring of transformer but this system is quite expensive and requires lot of manpower. various difficult situations can be faced by transformer if their health is not monitored regularly as shown in Fig 1 .The main drawbacks of these systems are that they are unable to give information about Voltage overloads& Current overloads and overheating of transformer oil & windings. Due to these, the transformer life is reduced.So, This proposed paper presents an implementation of iot based embedded system using microcontrollers and sensors to monitor the winding and oil temperature of a distribution transformer. The mentioned data are send to the remote server using IOT. on the basis of data's obtained from the sensors the controlling unit controls the load when any abnormalities arise in the distribution system. This system will help us to replace the equipment before any major fault occurs and power supply will not get disturbed as a result reliability of the system increases (goel, 2016).

Transformer standard Temperature range (in degree Celsius )	Condition	Remarks
<35	Cold	Considerable
35<Temp<40	Warm	Considerable
40<Temp<45	Very warm	Undesirable
>45	Hot	Undesirable

Fig 1: Data shown above is standard temperature range of transformer

### 3. LITERATURE REVIEW:

1. Pathak A.K, et al. [5] This paper represents a design and implementation of a mobile embedded system to monitor and record key parameters of a distribution transformer like oil temperature and winding temperature with a standalone single chip microcontroller 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. If any abnormality or an emergency situation occurs the system sends SMS (short message service) messages to the mobile phones containing information about the abnormality according to some predefined instructions programmed in the microcontroller. This mobile system will help the transformers to operate smoothly and identify problems before any catastrophic failure.

Disadvantage of Existing System:

- a. Firing of transformer can easily occur.
- b. Not accurate.
- c. Frequency interference in system.
- d. Noise problem in network.

2. Monika Agarwal et al. [6] This paper represents that they are designing a system where there exists communication between system and operator. For this we are using Transformer, microcontroller, logic level converter and GSM i.e. global system for mobile communication modem. This GSM modem helps to monitor transformer health by sending message to the system.

3. According to ABB (2000: 596-599) [8] the goal for condition monitoring is to identify fault before major failures so maintenance activities can be planned. Another goal for condition monitoring is to give possibility to skip unnecessary maintenance breaks. Same source divides condition monitoring to detection, diagnosis and prognosis of fault, action proposal and root cause analysis.

4. ABB Transformer handbook (2004: 123) [7] defines major goals for on-line monitoring system. The goals are to prevent major failures, to achieve better utilization of load capacity, optimize maintenance and to extend the remaining lifetime. These goals are more CBM related, which is supported by condition monitoring.

5. Hongan Mao, et al. [4] This paper represents a large number of power distribution transformer stations and they are far away from city, wireless GPRS transmission provides a good communication solution to supervise power distribution transformer stations. The scheme of remote wireless monitoring system for power distribution transformer station based on GPRS wireless network was designed in this paper. A control terminal system implement was mainly given, which adopted LPC2132 as main processor, GR47 as the data communication module. The monitor terminal software and flow chart were also designed. At last, the way of configuring the GPRS module to connect network is analyzed.

(D.Sarathkumar, 2018), (Luopajarvi, 2010)

#### 4. METHODOLOGY

In this system shown in Fig 2 we take two temperature sensors one for monitoring oil temperature and other for winding temperature. These data of transformer are sent to a remote location. These values are analog are given to programmable microcontroller. The values are then sent sequentially based on the frequency of

multiplexing mode of Analog to Digital Converter(ADC) by ATMEGA 328 microcontroller used. Then they are sent to the WIFI module that shows the data of real time in a connected PC/Laptop. The data can also be viewed in a LCD display which is connected with the microcontroller.

With Reference to IEC 60076-2

- Standard ambient temperature = 40 degree Celsius
- Oil temperature alarm setting = 95 degree Celsius
- Winding temperature alarm setting = 100 degree Celsius.

#### A) Hardware Requirements

- Distribution Transformer
- Temperature Sensor
- Bridge Rectifier
- Power Supply
- Analog to Digital Converter (ADC)
- ATMEGA 328 Microcontroller
- LCD Module
- ESP 8266 WIFI Module
- Buzzer
- Interfacing cable

Transformer is a singly excited static device which converts electrical power from one voltage level to other voltage level while maintaining its value constant, for constant frequency and constant flux. The main tasks performed by a transformer are:-

- 1) Changing voltage and current level.
- 2) Maintaining constant KVA, constant frequency and constant flux.
- 3) Impedance matching for maximum power transfer.

We have used LM35 (linear monolithic) is a temperature sensor having three pins i.e. from left 1st pin is Vcc, 2nd pin is output and 3rd is ground. In this sensor the analog voltage is directly proportional to temperature in

Celsius. It is an analog sensor. Sensitivity of this sensor is 10mv per Celsius.

Bridge rectifier has four diodes arranged in bridge circuit such a way that the output will be of same polarity irrespective of the polarity of the input provided. A voltage regulator is connected so as to get a constant 5V output.

ADC converts the analog input into digital output.

ATMEGA 328 is a high performance, low power single chip microcontroller with flash memory of 32 kilobytes. It is a 8 bit microcontroller. It is based on AVR RISC

architecture .It has 28 pins and 23 programmable I/O lines . The operating voltage range is between 1.8 to -5.5 volts and operating temperature is between -40 to 150 °C. ADC module has 6 channels with 10 bit resolution and 2kilo byte internal SRAM. It has two 8bit timer counter and compare mode and one 16 bit timer counter.

Liquid Crystal display abbreviated as LCD uses a liquid for displaying visible image. It is a passive display as it does not produce light of its own but modifies the existing light. These are super thin technology display screen as compared to CRT i.e. cathode ray tube that was used before. It works on the principle of blocking light instead of emitting light.

The ESP8266 WiFi Module is a small module with integrated TCP/IP stack protocol. It can provide microcontroller access to your WiFi network .The ESP8266 WiFi module is capable of hosting an application. It can also be used for offloading all WiFi networking functions from another processor.

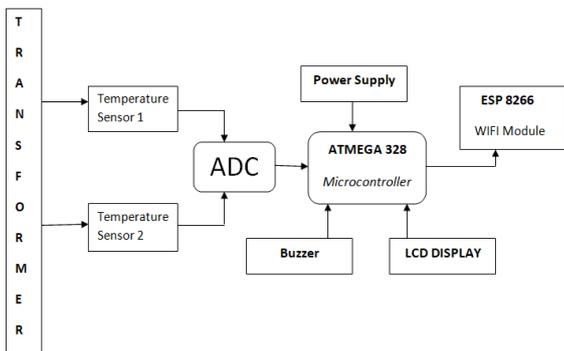


Fig.2: Block Diagram Of Designed System

Fig 2: Block diagram of designed system.

B) Software Requirements

- Arduino IDE
- Embedded C language

The Arduino Integrated Development Environment is a cross platform application used to write the program code and upload this code to arduino module. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

5. PROCEDURE :-

1. We supply an input of 230 volts ac to the transformer.
2. Transformer used is step down which converts 230 volt ac to 12 volt ac.

3. Now this ac output is converted to pulsating dc. So, we use rectifier which converts ac to pulsating dc.
4. With the use of capacitor (1000 microfarad), the pulsating dc is converted into pure dc.
5. Two voltage regulators (7805) are connected which is used to supply constant 5 volt dc to microcontroller and sensors.
6. The two temperature sensors senses the oil and winding temperature and sends it as input to the microcontroller which display these real time values in the LCD screen and at the same time these data values are remotely send over a Wi-Fi module(ESP8266) to the mobile phones located at the substation.
7. The range of the Wi-Fi module used is approx 300 meters.
8. In our proposed model we have assumed a threshold value of 40 degree celcius.
9. As the winding and oil temperature exceeds the threshold value (as the data shown in below table Fig 3) the buzzer starts alarming and we get the notification in the mobile phones displaying as “oil temp high” and “winding temp high”.

Variable parameters	Normal range(in degree Celsius)	Alarm setting (in degree Celsius)	Remarks
Oil Temperature	< 40	43	“oil temp high”
Winding Temperature	< 40	41	“winding temp high”

Fig 3: condition for oil and winding temperature in transformer.

5.1 Practical Circuit

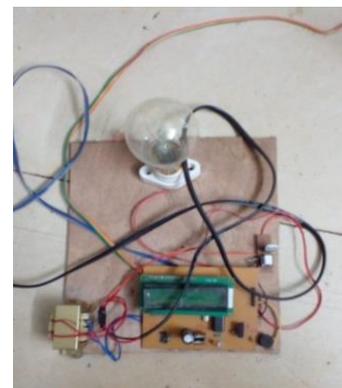


Fig 4

Figure 5 & 6 shown below is the working circuitry of this proposed project



**Below threshold value**

Fig. 5:



**Above threshold value**

Fig.6:

### 5.2 MERITS

Following are the advantages of the designed system:-

- Makes the Power System more economical, reliable and more sensible
- Easy monitoring of Internal Faults.
- Real-time monitoring is possible and the dependency on human power reduces.

### 5.3 DEMERITS

Following are the disadvantages of the designed system:-

- Interruption in network may result in delayed data transmission to remotely situated system.
- IOT based system require periodic maintenance.

## 6. RESULT AND DISCUSSION

This introduces a new method of transformer parameter monitoring using IOT. Sensors incorporated in the system collect the data of transformer. Main parameter of equipment such as oil and winding temperature. This sensed data is send to wifi module (ESP8266) through microcontroller and this controller checks parameter limits which further sent to IOT web server Blynk software using wifi module. This real time data monitoring are possible with the system as shown in fig.7&8 (Amol.A.Sonune, 2020).

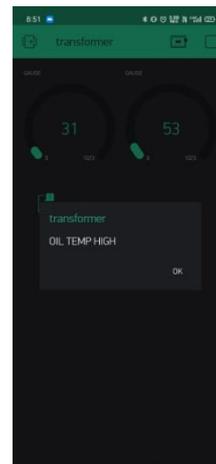


Fig.7

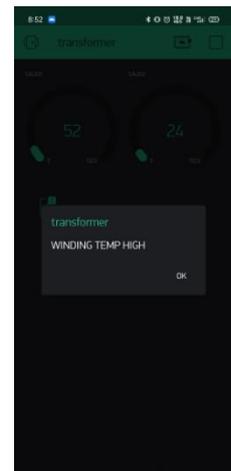


Fig. 8

Fig: above data shows the final output of this proposed project.

## CONCLUSION

Transformers are one of the most expensive equipment used in the power system. Regular health monitoring of transformer leads to increased reliability. The proposed technique with results has shown that this protection scheme has high accuracy against any abnormal fault condition. Earlier maintenance of transformer was done with the help of human power and pre-determine schedule. Now with growing technology we can use Wi-Fi module to receive any fault information remotely to the operator and authorities and help them to take quicker action against any faulty condition (asadi, 2020).

## 7. FUTURE SCOPE

In future we can develop some protection scheme for monitoring all parameters of transformers. We can also develop a control mechanism which can monitor temperature of transformer simultaneously and can provide instantaneous intervention in case of overheating or overloading of transformer therefore it leads to easy monitoring of remotely situated transformer thus increasing reliability, sensitivity and will prove more economical forever growing power system.

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