Intelligent condition monitoring for distribution transformer using GSM module

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Abstract **-As distribution transformers are very costlier in electrical industry therefore this paper presents the system which monitor different parameters of distribution transformer. There are two units which are remote terminal unit (RTU) and monitoring unit. Remote terminal unit consist of analyzing parameters such as current, temperature , rise and fall in oil level, vibration and humidity with the help of PIC 18F4550. All monitoring parameters are processed and if any abnormality occurs, the system sends Alert messages to the mobile phones and recorded in system memory through analog to digital converter. All parameters values are send to monitoring node through GPRS. If any emergency condition occurs immediately message send to the corresponding engineer through GSM and similarly on webpage we can get alert about it through GPRS. Near remote terminal unit buzzer will beep and LCD gives notification about emergency condition. An engineer at transformer cannot continuously keep an eye on transformer therefore given proposed system does communication with us at emergency conditions of distribution transformer through GSM/ GPRS module.**

Keywords:- Distribution transformer; PIC microcontroller; GSM/GPRS module;current; temperature; oil level; vibration; humidity; Remote terminal Unit (RTU); Monitoring Unit**.**

I. INTRODUCTION

The main backbone for any power distribution network is distribution transformer. In this paper we are developing on- line monitoring system which has many advantages such as information gathering, better management, condition assessment and decision making for engineers [2]. Main function of distribution transformer is to convert high AC voltage to low. Life of distribution transformer is dependent on the rated conditions. If transformer is working 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 caused by oil and windings .This proposed system overcomes all disadvantages of manual testing and improves life of transformer. Graphical representation of all the parameters give complete idea of working of transformer to engineer.

II. GPRS TECHNOLOGY

GPRS has full form as general packet radio service. This technology is a packet-switching technology which transfers data through cellular networks. This technology used by data communications, mobile internet, MMS. Speed of GPRS is called as 3G. The GPRS and GSM parameters of the system operate separately. The GSM & GPRS technology is used for voice calls, while GPRS data results voice and data can be sent and received simultaneously. GPRS is based on Global System for Mobile (GSM) communication and complements existing services such circuit-switched cellular phone connections and the Short Message Service (SMS).GPRS also complements Bluetooth, a standard for replacing wired connections between devices with wireless radio connections.

III. LITERATUREREVIEW

Vishwanath R have presented, this paper uses a temperature sensor ,pic microcontroller ,LCD display GSM board and xbee which is used for send the message to electricity board. By using this system we can detect multiple faults of three phase transmission lines which one can monitor the temperature, voltage, current by GSM modem. In this paper a system is develop to monitor the transmission line faults using GSM network [4].**Sachin Kumar B S** have discuss about it proposes a compact design and development of remote monitoring system for a three phase transformer. Arduino microcontroller and ZigBee based wireless device are used for monitoring the operating point of three phase transformer remotely. The Arduino microcontroller helps in monitoring the three phase current, voltage, temperature, and power of the transformer. The processed parameters are displayed on LCD which makes the system user friendly. All sensors required to monitor three phase parameters by single microcontroller, which makes the system compact [5].

IV. SYSTEMDESIGN

1. HardwareDesign:

Figure one shows Distribution transformer condition monitoring hardware setup of computer aided design using 3D modeling. PIC 18F4550 Microcontroller with different 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 getting all parameter values from microcontroller are displayed on LCD and similarly on web page.

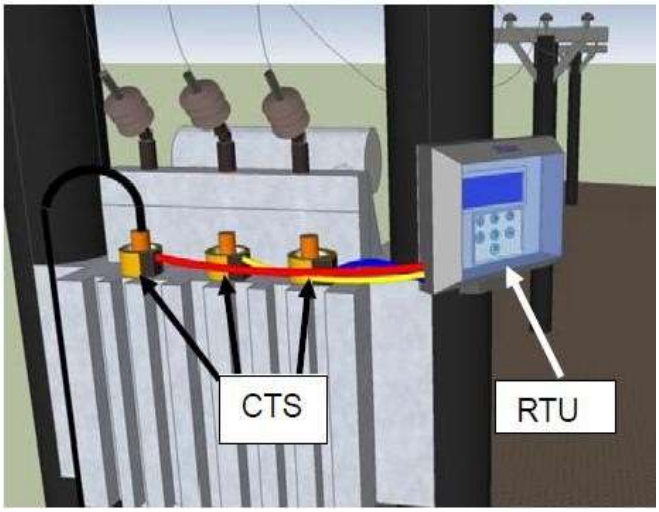

Fig.1. Distribution transformer condition monitoring hardware set up design

GSM/GPRS module sends all parameter values to webpage as online interface to engineers. If any emergency condition occurs like overvoltage, overcurrent, rise and fall of oil level, increased temperature range, abnormality in vibrations and change in humidity affects the transformer life, so we are informing engineers by giving notification by SMS through 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 proposed system is discussed below

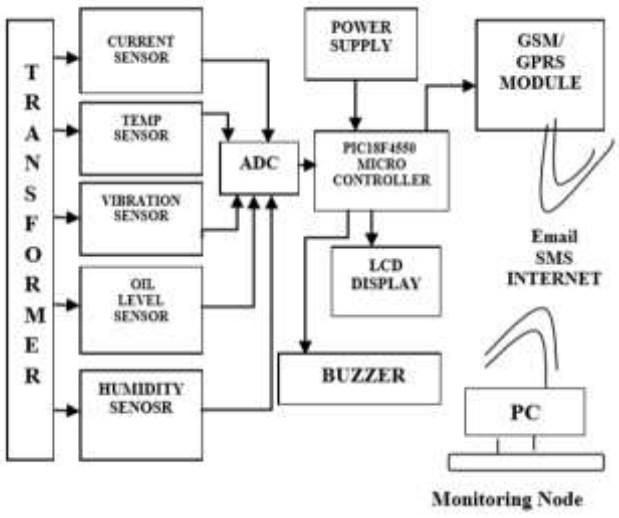

Fig.2. Block diagram of distribution transformer monitoring system

Brief introduction about components is given below.

a) Temperature Sensor:

LM35 measures temperature of windings for distribution transformer. As temperature sensor is integrated circuit sensor which gives analog output [14]. Voltage increases whenever temperature rises. Actually sensor records any voltage drop between the transistor base and emitter. This voltage is then amplified and gives analogue signal that is proportional to the temperature.


Fig.3. LM35 temperature sensor

b) Oil Level Sensor :

In given proposed system we are placing oil level sensor at the tank of transformer. Level of oil is measured with float. Float tells us the oil level and accordingly we get analog output voltage[7]. This output voltage has given to ADC of microcontroller.

c) Current Measuring Circuit:

Current of the transformer is calculated 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 dedicated 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 through the current sensor [13].

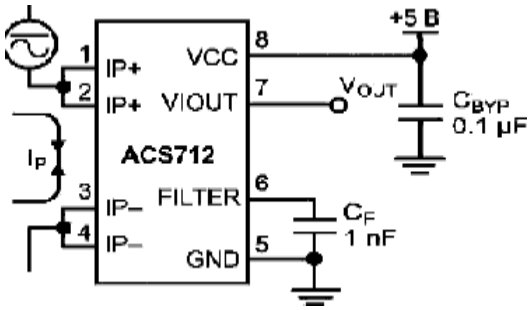

Fig.4. ACS712 IC with basic connections.

d) Humidity Sensor:

Relative humidity is sensed by humidity sensor, means it measures both air temperature and moisture. Relative humidity is measured in percentage, which is the ratio of moisture present time to the total amount of moisture present in air, at that temperature can hold. It works on the basis of changes in temperature or changing electrical currents in air.

e) Vibration Sensor:

Displacement, velocity and acceleration are three parameters are used for detection of vibrations. Vibration switch SW-420 is used for detection of vibrations with LM393 comparator. Previously Vibration switch is considered as vibration sensor as it has high sensitivity.


Fig.5. LM393 Vibration Sensor

f) 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 module [11]. After inserting SIM card we can control module by sending instructions.

Fig.6. GSM/GPRS Module

2) Software Design:

The software is responsible for managing the PIC microcontroller & devices are connected to it.

a. Database Management

Database for transformer is created due to tworeasons:

i. If engineer wants to refer previous data which is stored at database of transformer then he can get the idea about transformer condition.

ii. Engineer cannot continuously keep an eye on transformer conditions therefore previous data is stored in database as data is updated periodically on webpage.

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

b. ApplicationDevelopment

Now days everywhere internet is used and becoming a communication network to people. We are taking private IP address 172.16.3.57 and displaying webpage using GPRS. Therefore in given proposed system we are making communication between transformer and people through webpage.

V. ALGORITHM OF PROPOSEDSYSTEM

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

1) End.

VI. TESTS &RESULTS

After testing of proposed system, it provides following results:

1. Current > 10A = Current Fault
2. Temperature > 40^0c = temperature fault
3. Oil Level < 30 ML = Oil Level fault
4. Vibration > Normal Transformer Vibrations= Vibration Fault
5. Humidity > 25% = Humidity Fault

Therefore any abnormality condition occurred in above rated condition, this changes shown in the LCD at RTU side, also same data monitored at monitoring node sent via GSM/GPRS system on webpage. All above results for normal conditions of Parameters are displayed on webpage which is shown in below figure.5.

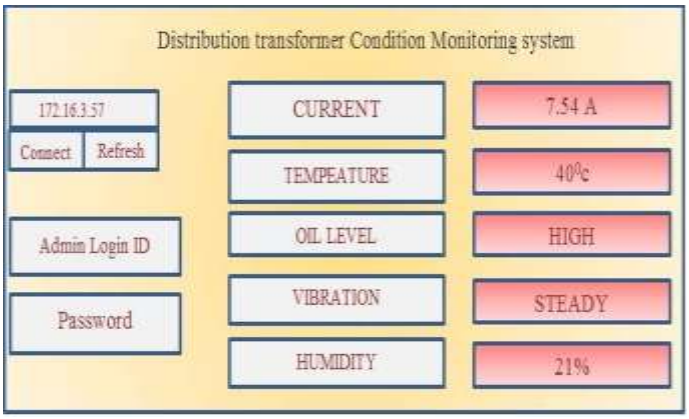

Fig.7. Distribution transformer condition monitoring system displaying on webpage.

If abnormality conditions occur then automatically values box for particular condition will glow red for showing alert. Figure 6 shows graphical representation for oil level of transformer.

VII. FUTUREWORK

In future work we can develop database of all parameters of distribution transformer which are placed at different places .We can get all information by placing the proposed system modules at every transformer. We can send the data through Wifi module and also through Ethernet shield. With Ethernet shield we can make remote terminal unit as a server and store data on webpage or website. Wi-Fi module connect to nearby network and send information to monitoring node.

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

VIII.CONCLUSION

All disadvantages of manual monitoring of distribution transformer are overcome by given proposed 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 proposed system to alert about emergency conditions to the engineers so we can increase the life of transformer.

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