International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

MICRO CONTROLLER BASED TRANSFORMER PROTECTION

Kiran H C[1], Madhushree M S[2], Roopesh N P[3], Shivasharana[4], Dr. Shankaralingappa C B[5]

UG students, Dept of EEE, Dr. Ambedkar Institute of Technology, Bangalore
Professor, Dept of EEE , Dr. Ambedkar Institute of Technology, Bangalore

A B S T R A C T

Healthiness of transformer is very important to maintain stability of power system.This paper is focused on monitoring of different parameters of transformer to ensure the healthiness of the transformer through wireless system. Oil level, temperature and voltage level of transformer are monitored continuously. This monitoring system consist of voltage sensor, LM35 temperature sensor, oil level sensor, current sensor, ESP8266 and LCD. Online monitoring system integrates a GSM modem before any catastrophic with a stand-alone single chip microcontroller and different sensor. Mobile networks and GSM technology are attractive option due to lower cost. If any abnormality occurs the system sends SMS to the mobile phone with abnormality based on predefined instructions coded in microcontroller. This mobile system helps the transformer to operate smoothly without any failure.

Keyword :GSM, Microcontroller, Sensor.

1. INTRODUCTION

The most crucial equipment of transmission and distribution of electrical power is transformer. They are used for electricity distribution and transmission which reduces the primary voltage to utilization voltage for customer use. Transformer life is significantly reduced if they are subjected to overloading, heating, low or high voltage/current results in unexpected failures and interruption of supply to a large number of customers thus effecting system reliability. Hence their parameters such as voltage, current, temperature and oil level as to be monitored periodically in order to increase the life span of transformer. An engineer at transformer cannot continuously keep an eye on transformer. The main concern with transformer protection is protecting the transformer against internal faults and ensuring security of protection scheme for external faults. Most power companies use supervisory control and data acquisition (SCADA) system for online monitoring of power transformers but extending the SCADA system for online monitoring of distribution transformers is an expensive way of

monitoring of transformer. Distribution transformer are currently monitored manually when a person periodically visits a transformer site for maintenance and records parameters. This type of monitoring cannot provide information about occasional overloads and overheating of transformer oil and windings. All these factors can significantly reduce transformer life. A number of technologies are currently being used for offline as well as online monitoring of power transformer. 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 we use power carrier communication to send data the real time data transmission, reliability cannot be guaranteed. Various relaying principles have been proposed and used to protect transformer against faults. Electromechanical and solid-state relays were used for protecting power system for the past several years. Researchers have been studying the feasibility of designing relays using microcontroller. Therefore, given proposed system does communication at emergency condition through GSM. All monitoring parameters are processed and if any abnormality occurs the system sends alert messages. The proposed monitoring system works in real time.

2 METHODOLOGY

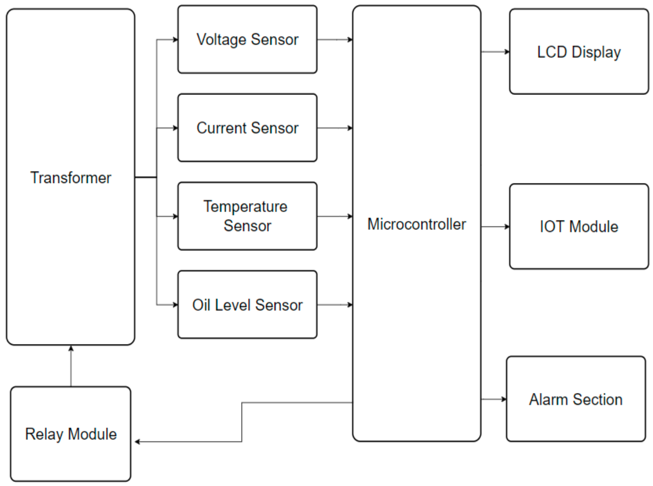

Fig 1: Block diagram of the proposed system

3 .HARDWARE COMPONENTS

- Microcontroller
- Transformer
- Wi-Fi Module
- Current sensor
- Voltage sensor
- Temperature Sensor
- Oil level sensor
- Alarm
- Relay Module
- LCD display

LM35 Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). It can measure temperature more accurately than a using a thermistor.

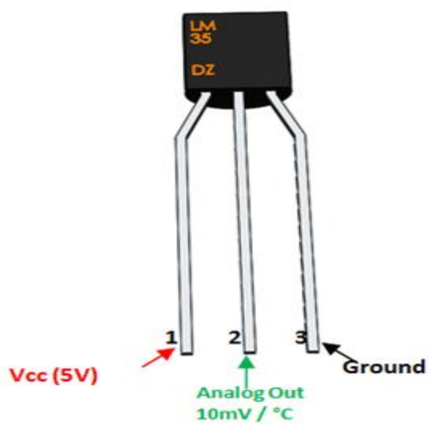

Fig 2: LM35 Temperature sensor

Current Sensor

The module is designed using the ZMCT series of small size high-precision micro CT and high-precision operational amplifier circuits for more accurate sampling and proper signal compensation. It is best solution for the signal acquisition of AC current within 5A range.

Fig 3: ZMCT103C Current sensor

Oil Level (ultrasonic sensor)

An ultrasonic level transmitter is mounted on the top of the tank and transmits an ultrasonic pulse down into the tank. This pulse, travelling at the speed of sound, is reflected back to the transmitter from the liquid surface. The transmitter measures the time delay between the transmitted and received echo signal and the on-board microprocessor calculates the distance to the liquid surface.

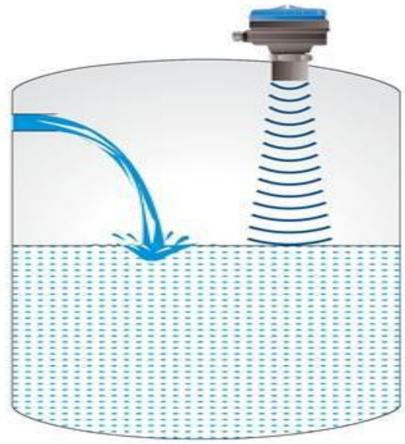

Fig 4: Oil level sensor

Voltage Sensor

A voltage sensor is a sensor is used to calculate and monitor the amount of voltage in an object. The resistor in the circuit works as a sensing element. The voltage can be separated into two resistors like a reference voltage & variable resistor to make a circuit of the voltage divider.

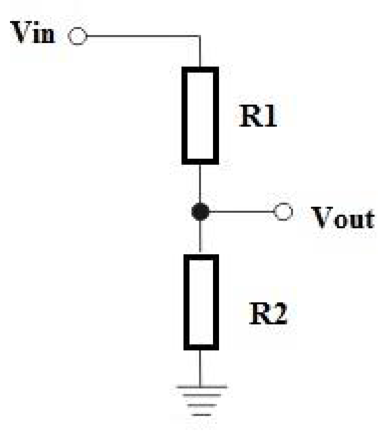

Fig 5: Voltage sensor

Liquid Crystal Display

The liquid crystal display uses the property of light monitoring of liquid crystal and they do not emit the light directly. The Liquid crystal display is a flat panel display or the electronic visual display. The 16×1 display unit has the 16 characters which present in one line and 16×2 display units have 32 characters which are present in the 2 line.

Fig 6: LCD display

4. WORKING PRINCIPLE

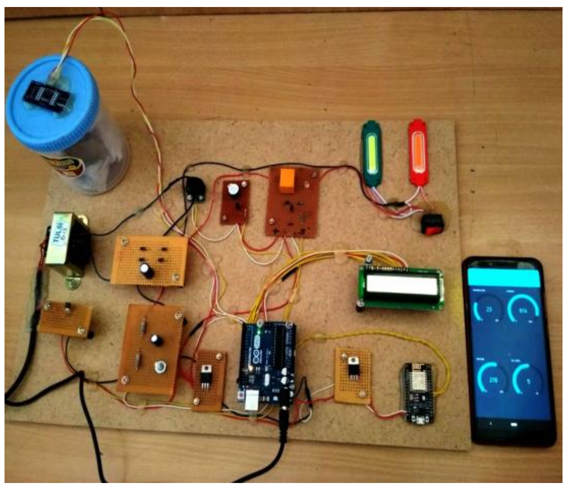

Fig 7: Hardware of the proposed system

For this proposed real-time framework we have used a voltage sensor, oil level sensor, a current sensor and a LM35 temperature sensor for measuring voltage, current, temperature respectively. These three analog values are taken to analog pin of programmable microcontroller arduino. These analog values are given to A to D converter for converting this analog values into digital one. Microcontroller will read all sensor values one by one and then it will process the sensor data. Then the values are then sent directly through Wi-Fi module that displays the data in an internet connected IOT section for monitoring . All values are compared with threshold values, if any fault detected the microcontroller will send alert message. The relay will sense thefault and disconnects the transformer from supply. The supply of power is given through stepdown transformer (230/12V). This 12V AC is converted to DC using a bridge rectifier and then regulated to +5V using a voltage regulator 7805 which is required for the operation of the arduino, LCD display and other interfaced sensors.

6. FLOW CHART

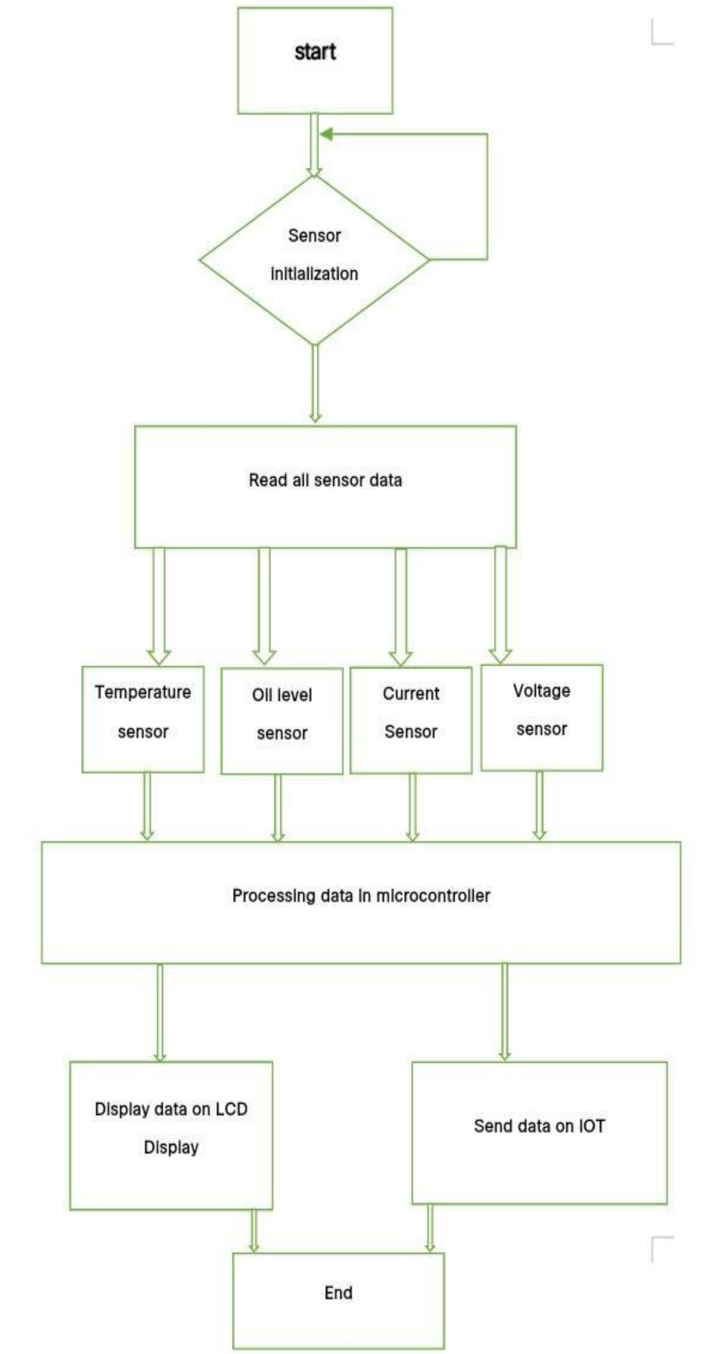

Fig 8: Flow chart of the proposed system

7. ALGORITHM FOR PROPOSED SYSTEM

(1) Start
2) Initialize the proposed system with GPIO pin.
3) Current sensor, temperature sensor, oil level sensor and voltage sensor will sense the parameters.
4) Convert analog to digital.
5) All values from sensors are passed to the microcontroller.
6) Microcontroller display these values on LCD.

7) Compare with pre-set value.
8) For abnormal values, give alert alarm.
9) Send these values to IOT Cloud server.
10) End

8. TEST RESULTS AND DISCUSSION

230volts AC supply is given to the transformer which is stepped down to 12volts. The sensors will sense various parameters of the transformer. The bridge rectifier circuit converts the AC supply into DC.

The temperature sensor LM35 will sense the temperature of the transformer by using thermistor principle in ^{O}C and the value will be fed to Arduino analog pin A0. If the temperature is above 40 ^{O}C (high temperature), over temperature fault occurs and the buzzer will give the alert to the user and will be displayed on the LCD.

The current sensor ZMCT103C connected to Arduino pin A1 sense the AC current in mA up to 5amps AC. If any over load occurs the sensor will sense the fault and the buzzer gives the alert and the signal will be sent to relay to trip. The over load fault will be displayed on the LCD.

Table 1: Test results of current sensor

CURRENT IN mA	FAULT CONDITION	LOAD SWITCH
620	NORMAL OPERATING CONDITION	OFF
811	OVER LOAD FAULT	ON

The oil sensor connected to Arduino digital pin 18 uses the ultrasonic level principle. When the amount of oil is low or high it will be displayed on LCD indicating LOW or HIGH level. The ultrasonic level sensor will transmit the signal and the same signal is reflected back to the sensor. The sensor will calculate the difference between the transmitted signal and reflected signal. Based on the difference the sensor will calculate the level of the oil using the formula

$$Distance = Speed\ of\ sound * Time$$

Table 2 :Test results of Oil level sensor

OIL IN CM	OIL LEVEL
0	-1
1	2
2	3
3	4
4	5
5	5
6	6
7	7
8	8

The voltage sensor uses the voltage divider circuit to sense the voltage. It is connected to the Arduino analog pin A2. When the voltage is below 180volts, under voltage fault occurs and alert is given to the relay, the relay trips and disconnects the supply of the transformer. When the voltage Is above 240volts over voltage fault occurs. When there is difference in the pre-set values, the fault occurs and the alert is given to the user. All these sensor values will be uploaded to IOT Wi- Fi module for future reference and also displayed in blynk app. All the analog values will be converted to digital values before feeding the values to the Arduino using analog to digital converter(ADC) which is inbuilt in Ardino.

Table 3: Test results of Voltage sensor

VOLTAGE IN VOLTS	FAULT CONDITION
<180	UNDER VOLATGE FAULT
180 – 240	NORMAL OPERATING CONDITION
> 240	OVER VOLTAGE FAULT

9. CONCLUSION

This proposed system provides the prototype model of monitoring and protection of real time transformer using IOT. In a distribution network there are many distribution transformers can be monitored using the said technology through mobile. The sensors incorporated in the system collects the data of transformer parameters such as voltage, temperature, oil level and current. These parameters are continuously monitored and transmitted to nearestelectrical office for necessary actions. Thus, the real time data collection and monitoring of the transformer parameters are possible with the system.

10. REFERENCE

[1]. Basil George 1 , Felix Babu 2 , Vishnu Mohanan3, Thomas George4 "Remote Monitoring of Transformer using Microcontroller" IJAREEIE Vol. 6, Issue 3 pp: 1909-1914 , March 2017

[2]. Mr.D.Sarathkumar1 , Uvaraj.M2 , Kabilesh Kumar C V3 , Kalaiselvi A4 "Real Time Transformer Health Monitoring System Using IOT" IJAREEIE Vol. 8, Issue 3, pp: 783-790 March 2019

[3]. Pallavi Roy1 , Pritam Misra2 , Paramananda Saharia3 , Rituraj Sarma4 , Santanu Pathak5 "A Study of Remote Monitoring of a Transformer using IoT" IJAREEIE Volume 9, Issue 7, pp: 1908-1913 July 2020

[4]. Anand shivashimpi1 ,Mrunal Pawar2 , Sunita Ghade3 , Priyanka Nandoskar4 , Gorakh Viadhya5 "Real Time Transformer Health Monitoring System using IOT" IJAREEIE Vol. 8, Issue 11, pp: 2426-2429 November 2019

[5]. Hariharan.R, Choudri Thangavel.MM, Naveen.V, Sabarish Prabakar, Siva Prakash.K "Wireless Transformer Monitoring System" IJAREEIE Volume 10, Issue 3,pp: 769-774 March 2021