Transformer Monitoring using IoT Technology

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***Abstract*:- In this paper, a smart IoT based fault detection and location system was used to indicate and locate the exact spot where fault had occurred. it will provide a shorter response time for technical crew to rectify these faults and thus help to save transformers from damage and crash. These systems use a current transformer, a voltage transformer, ARDUINO Microcontroller, ESP8266 module. This system automatically finds faults, analyses and classifies these faults and then, calculates the fault distance from the control room using impedance- based algorithm method. Definitely the fault information is transmitted to the control room. In conclusion, the time required to locate a fault is desperately reduced, as the system automatically and exactly provides accurate fault location information.**

Keyword: Distribution transformer, Microcontroller, Sensors, monitoring unit, LCD display, ESP12-E wifi module.

1. INTRODUCTION

Electricity plays an important role in our life. Every moment of our life depends upon electricity. Electricity has several components and equipment helping human to transfer and regulate the distribution according to usage. The most crucial equipment of transmission and distribution of electric power is transformer. In power systems, an electrical equipment distribution transformer directly distributes power to the low-voltage users and its operation condition is an important criterion of the entire network operation [1]. The majority of these devices have been in service for many years in different (electrical, mechanical and environmental) conditions. They are the main components and constitute a large portion of capital investment. Operation of distribution transformer under rated condition (as per specification in their nameplate) guarantees their long service life. However, their life is significantly reduced if they are subjected to overloading, heating, low or high voltage/current resulting to unexpected failures and loss of Supply [2].

2. WORKING PRINCIPLE

The project houses a IOT device and a smart electronic monitoring device attached to the transformer. Many parameters of the transformer such as temperature, Oil level, are monitored continuously by the electronic device. If there is fault in any of the parameters the system acts immediately and form as message that is automatically transmitted via IOT device to the government web portal (ex. tangedco). It can be made to send to more than one person if necessary. The modem communicates with the embedded system in a unique way. The embedded system consists of an advanced microcontroller that can communicate with the IOT device. This immediate transfer of information will result in faster response time by the authorities and the poser shut of time will also be reduced drastically [3].

❖ **HARDWARE REQUIREMENTS:**

- Microcontroller
- Liquid sensor
- Temperature Sensor
- Level sensor
- IOT device
- LCD
- Power Source
- Jumper Wires

❖ **SOFTWARE REQUIREMENTS:**

- Arduino IDE
- IOT PLATFORM

❖ **APPLICATION:**

- This system can be used in Electricity Board to find the faults in the transformer automatically which will reduce the processing time.

3. COMPONENT DESCRIPTION

3.1 SUPPLY CIRCUIT

The supply circuit is used to give the proper power supply to the circuits. The single phase AC 230volts is step down into 12V by step down transformer. The step down AC voltage is fed into the power supply circuit. The power supply circuit provides +5V,-5V, +12V,-12V. The arduino and LCD display requires 5V and driver circuit requires both 5V and 12V.

3.2 ARDUINO

Arduino is open source hardware and software user community that designs and manufactures single board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control both physically and digitally [4]. Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of program to the on-chip flash memory. A program for Arduino hardware may be written in any programming language with compiler that produces binary machine code for the target processor.

Table: 1 Existing Vs Proposed System

Existing System	Proposed System
In this existing system the worker has to find the fault manually.	Sensor based intelligent fault detection system is mainly conceptualized in such a way that the time

Drawbacks of existing system: The time requires for identifying the fault is more. The worker has to go manually to identify the fault.	required to identify the fault is reduced. **Advantages of proposed system:** The time required for identifying the fault is less. The microcontroller will send the identified fault to the WEB SERVER using IOT technology.

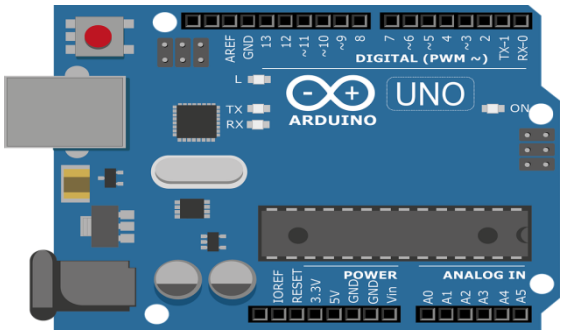

Fig.1 Arduino Board

With help of this device we can read the input values using sensors and controls the measured parameters.

3.3 TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The LM35 is operated at -550 to +1200 C. The LM35 can read the data using arduino and it can be stuck or established to a surface and its temperature will be within around the range of 0.010 C of the surface temperature. The output of LM35 temperature can be given to comparator circuit and can be used for over temperature indication.

3.4 ULTRASONIC SENSOR

Ultrasonic sensors are used for distance measuring applications. These gadgets regularly transmit a short burst of ultrasonic sound to a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound within the medium. Different sorts of transducers are utilized within industrially accessible ultrasonic cleaning devices. An ultrasonic transducer is affixed to a stainless steel pan which is filled with a solvent and a square wave is applied to it, conferring vibration energy on the liquid. The ultrasonic distance sensors measures distance using sonar; an ultrasonic beat is transmitted from the unit and distance-to-target is determined by measuring the time required for the echo return. Output from the ultrasonic sensor is a variable width beat that compares to the distance to the target [5].

3.5 CURRENT SENSOR

The allergo ACS712 current sensor is based on the principle of Hall Effect. According to this principle, when a current carrying conductor is placed into a magnetic field, a voltage is generated across its edges perpendicular to the directions of both the current and the magnetic field. It is used to measure the alternating high current. It steps down ac current to lower value so that it can be easily read with the help of microcontroller.

3.6 LCD DISPLAY

An LCD is made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched ON and OFF more frequently improving the screen fresh time.

3.7 IoT

The ESP8266 Wi-Fi module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your arduino device and get about as much WiFi ability as Wi-Fi offers. The ESP8266 module is an extremely cost effective board with a huge and ever growing community

4. RELATED WORK

Fig.2 Working Model

The process of designing and implementation real time transformer health monitoring system is carried out by arduino. The step down transformer and power supply circuit is used to give supply to the arduino and LCD display. In this project parameters like voltage, current, oil level, oil temperature and winding temperature is sensed through the respective sensors. The sensed level values are given to the arduino.

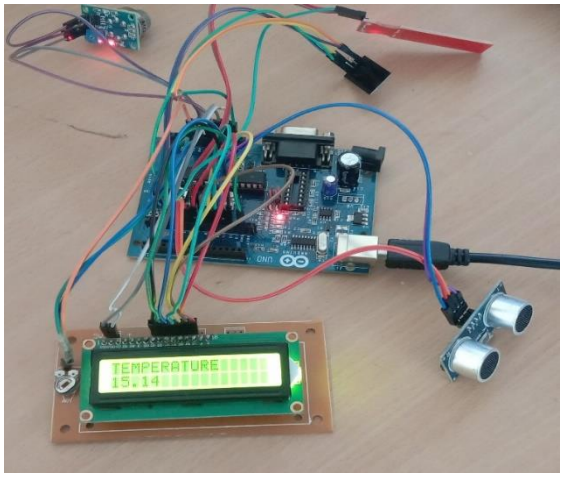

Fig.3 Normal Condition of Transformer

Arduino calibrates the given input values and it provides the necessary output as programmed in it. The programmed output is displayed through the local display LCD screen. The same output is also transmitted through the Wi-Fi module to the internet server programmed in the arduino. Data's will be saved and could be used for the further analysis. The GSM modem is used as a short message server (SMS) device that transmits parameters as an SMS.

5. PROPOSED WORK

The main objective of this project is to design and implement an embedded mobile and IoT based system to measure, over voltage, Load current, Oil level, Oil temperature and Winding temperature.

6. METHODOLOGY

Our work includes the process of monitoring the transformer performance in which the over voltage, over current, oil level, oil current and winding temperature is measured and it is compared with the nominal value in the comparator. If the measured value varies, the system will send an error alert to the concern person.

7. CONCLUSION

A mobile monitoring system for distribution transformer was designed, implemented and tested. The designed system is connected to a distribution transformer and is able to record and send abnormal operating parameters information to a mobile device using a GSM network. The time to receive the SMS message varied from 2-10 seconds and this is due to the public GSM network traffic. The system hardware was constructed from off- the- shelf components. The experimental results came out as expected. A server module can be added to this system to periodically receive and store transformer parameters information about the entire distribution transformer of a particular utility in a database application. This database will be a useful source of information on the utility transformers. The stored data can be analyzed to help the utility in monitoring the operational behavior of their distribution transformers and identify faults before any catastrophic failures thus resulting in significant cost saving as well as improving system reliability.

8. REFERENCES

[1] Implementation of a Transformer Monitoring Solution Per IEEE C57.91-1995 Using an Automation Controller Walter A. Castillo CenterPoint Energy Rekha T. Jagaduri and Prasanna K. Muralimanohar Schweitzer Engineering Laboratories, Inc.

[2] Distribution Transformer Monitoring for Smart Grid in India, 1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES-2016).

[3] A new Method for Monitoring of Distribution Transformers, SH. Mohamadi Department of Electrical Engineering K.N Toosi University of Technology Tehran, Iran.

[4] GSM-Based Distribution Transformer Monitoring System. Abdul-Rahman AI-Ali, Abdul Khaliq & Muhammad Arshad School of Engineering, American University of Sharjah Box 26666, AUS, Sharjah, United Arab Emirate, IEEE MELECON 2004, May 12-15,2004, Dubrovnik, Croatia

[5] Prof. M. S. Sujatha & Dr. M Vijay Kumar, "On-Line Monitoring And Analysis of Faults in Transmission and Distribution Lines Using GSM Technique", Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, E-ISSN: 1817-3195, 30th November 2011, Vol. 33 No.2.