REAL TIME TRANSFORMER HEALTH MEASURING SYSTEM USING IOT

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Abstract

This paper presents the design and implementation of a transformer to measure load currents, over voltage, transformer oil level and oil temperature. This is implemented by using on-line measuring system using Internet of Things (IOT), with single chip arduino microcontroller and sensors. The output values of sensors are measured and stored in the system memory. System is programmed with some predefined instructions to check abnormal conditions. If there is any abnormality on the system, details are automatically updated in the internet through serial communication. This Internet of system (IOT) will help the utilities to optimally utilize transformers and identify problems before any catastrophic failure occurs. Thus online-measuring system is used to collect and analyze temperature data over time. So Transformer Health Measuring will help to identify or recognize unexpected situations before any serious failure occurs and it leads to a greater reliability and significant cost savings.

Index terms---Arduino, IOT, Online Monitoring Transformer Health acquisition and transformer condition measuring has been an important issue. In this paper, transformer is designed with arduinouno board attached with Ethernet shield to measure and control the parameters of the transformer. The measured parameters of multiple transformers are transmitted and processed in a web page through serial communication. If the measured values of transformers are properly maintained, then the transformer will continue its normal functions. But if they exceed, it will notify the abnormal condition values in the IOT web page.

1. INTRODUCTION

Electricity plays an important role in our life. Every moment of our life depends upon electricity. Electricity has several components and equipment, providing human to transfer and regulate the power according to their usage. The most important and influential equipment of transmission and distribution of electric power is transformer. As a large number of transformers are distributed over a wide area in present electric systems, it’s difficult to measure the condition manually of every single transformer[5]. So, automatic data
time. Due to this, the time taken will be more to test the transformer. The main disadvantage of the previous system is, in case if we do not monitor the health condition of the transformer continually, serious failure may occur.

3. PROPOSED SYSTEM

In proposed method, we implement a Transformer health measuring system in real time applications based on internet of things. Here we used a temperature sensor, voltage divider sensor, current sensor, and ultrasonic level sensor in transformer. The voltage divider sensor measure the voltage produces in the transformer, current sensor measure the current produces in the transformer, temperature sensor measure the temperature of the transformer and the ultrasonic level sensor measure the oil level in the transformer. In this system data are measured from sensors with the specified values given through the arduino. Then the arduino controller starts to compare the incoming values with the saved values in the EEPROM memory. When there is at least one parameter’s value denied the saved value, then the arduino controller takes action to update the details in the webpage. So, this system will help to identify the abnormal condition of the transformer. The advantage of our system is if transformer is in abnormal condition we can know from anywhere and no human power are needed to monitor the transformer.

3.1. Block Diagram

The block diagram consists of temperature sensor, voltage divider sensor, current sensor, and ultrasonic level sensor. These sensors are connected to the arduino board and the measured values are given to the web page through the serial communication.

4. HARDWARE DESCRIPTION

4.1. ARDUINO UNO

Arduino Uno consists of 14 digital pins which acts as a input/output pins (of which 6 can be used as PWM outputs), 6 analog pins acts as inputs, a 16 MHz crystal oscillator, USB, a power jack and a reset button.

It comes with an open source hardware feature which enables users to develop their own kit using already available one as a reference source. We can develop an Arduino based project which can be completely stand alone or projects which involve direct communication with the software loaded in the computer.
4.2. POWER JACK
Arduino can be power either from the PC through a USB or through external source like adaptors or battery. It can operate on an external supply of 7 to 12V. Power can be applied externally through the pin Vin or by giving voltage reference through the IOREf pin.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC to DC adapter (wall-wart) or battery. The adapter can be connected by plugging.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

4.3. DIGITAL INPUTS
It consists of 14 digital pins which are inputs/output pins, each of which provide or take up 40mA current. There are some special functions like pins 0 and 1, which act as RX and TX respectively, for serial communication, pins 2 and 3 which are external interrupts, pins 3,5,6,9,11 which provides PWM output and pin 13 where LED is connected.

4.4. ANALOG INPUTS
It has 6 analog input/output pins, each providing 10 bits of resolution.

4.5. AREF
It provides reference to the analog inputs.

4.6. RESET
It resets the microcontroller when low.

5. SENSORS

5.1. VOLTAGE SENSOR
A voltage sensor is a device which detects the voltage in a wire and generates a signal proportional to it. The generated signal may be analog current or voltage or even in digital output. Then this will be utilized to display the measured voltage by a voltmeter or may be stored for more analysis in the system for controlling purpose.

fig. 3.1. Voltage Sensor

This module is based on resistance point’s pressure principle, and it can make the input voltage of red terminal to reduce 5 times of original voltage. The max Arduino analog input voltage is 5 V, so the input voltage of this module should be not more than 5 V.

5.2. CURRENT SENSOR
A current sensor is a device that detects electric current in a wire and generates a signal proportional to it. The generated signal could be analog or current or even digital form. Then used it to display the measured current in an ammeter or can be stored for analysis in the system for control purpose.
5.3. TEMPERATURE SENSOR
The temperature sensor is the simple ON/OFF thermostatic devices which control a heating system to highly sensitive semiconductor types that can control complex process of the furnace. Temperature Sensors measure the heat or cold (energy) that is generated by an object, allowing us to “sense” or detect temperature producing either an analogue or digital output. Here we are using the LM35 centigrade temperature sensor.

The temperature sensor functional module consists of two parts: the function module box and the probe head. The LM34 temperature sensor is mounted on the probe head. By replacing the LM34 with another precision integrated-circuit temperature sensor LM35, we can easily get an output voltage proportional to the centigrade temperature.

5.4. ULTRASONIC SENSOR
The sensor transmits an ultrasonic wave and produces an output pulse and it measures the oil level of the transformer. By measuring the echo pulse width, the distance to target can easily be calculated. With the sensor oriented as shown alongside, locate Pin-1 as the 1st pin on the left hand side.

6. ALGORITHM
Programs written in Arduino are known as sketches. A basic sketch consists of 3 parts
1. Declaration of Variables.
2. Initialization: It is written in the setup () function.
3. Control code: It is written in the loop () function.

STEPS TO PROGRAM AN ARDUINO
• The sketch is saved with .ino extension.
• Operations like verifying, opening and saving a sketch can be done using the tool menu.
• The sketch should be stored in the sketchbook directory.
• Chose the proper board from the tools menu and the serial port numbers.
• Click on the upload button. Thus the code is uploaded by the boot loader onto the arduino board.

BASIC ARDUINO FUNCTIONS
• digitalRead(pin): Reads the digital value at the given pin.
• digitalWrite(pin, value): Writes the digital value to the given pin.
• pinMode(pin, mode): Sets the pin to input or output mode.
• analogRead(pin): Reads and returns the value.
• **analogWrite**(pin, value): Writes the value to that pin.

• **serial.begin**(baud rate): Sets the beginning of serial communication by setting the bit rate.

### 7. RESULT

By placing the arduino board from the library, connections are made. The digital pins 0 and 1 represents Tx and Rx, connected to the virtual terminal. The analog pins are connected to the temperature sensor, current sensor, voltage sensor and ultrasonic sensor and the negative terminal are grounded.

By varying the sensor values, the data are measured and displayed in the web page and through virtual terminal. This will show the abnormality conditions to the IOT page and monitored by the in-charge of the transformer condition.

![fig.4. Simulation](image)

![fig.6. Online Measuring Output](image)

If the temperature value is increased above 40, it will notify high temperature. It will maintain the normal condition until it exceed the given value. When the coolant level is in normal condition, the coolant level is is displayed in the page. It will measure the condition whether it is a low level coolant or high level coolant.

### 8. CONCLUSION

Transformers are expensive piece of equipment of the transmission and distribution system. It is difficult to measure the transformer at all the time. So, for this purpose, IOT based transformer measuring system was designed, implemented and tested. It is useful when compared to manual monitoring and measuring the oil level and the sensor values. A server module can be

added to this system to periodically receive and store transformer parameters information about all the power transformers in a database application. After receiving the message on any abnormality, we can take immediate action to prevent any catastrophic failures occurs. This type of health condition of transformer increases the life of transformer, reliability and decreased cost of power system operations.

9. FUTURE PERSPECTIVE

A healthy well maintained large power transformer is used for many years because of this online measuring system. Therefore, the sensors should maintain the stability on the time scale of years (more preferably for the full lifetime of the transformer) and survive in oil environments [9]. In future perspective, the man power will also be reduced and becomes systematic.

REFERENCES


[7]. “Selection Criteria for Oil Transformer Measurements to Calculate the Health Index” in IEEE Transactions on Dielectrics and Electrical Insulation, Vol.23, No.6, December 2016.


