Transformers monitoring using Arduino

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Abstract:- In this paper main objective is to design a protective circuit for distribution transformer, supported programmable controller to watch transformer ambient temperature, voltage level, current level and oil level by using various sensors. Here the most perspective is to beat or reduce the faults occurring in transformer because of various factor like over-voltage, over-current, temperature rise and oil-level decrement. Designing a value efficient and high performing system which is able to sense the faults and it'll display all the parameters of transformer on the application by means of WI-FI module (ESP8266) by using API technology (Application programming interface) that there's a problem within the perspective transformer in keeping with that user can check the status of the transformer.

Keywords:- Controller, Sensor, Over-voltage, over-current, Temperature, Oil-level, WI-FI module (ESP8266), API technology, Application.

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1. INTRODUCTION

Transformer are to be foremost important a part of substation and grid. The speed of failure of transformer in India is around 12 to 15% which is kind of in higher rate. Failure of the transformer is most typical in industry which causes economical loss and it also reduce the lifetime of transformer to three year itself, normally the lifetime of transformer 25 to 30 years.

➢ Following are a number of the foremost common causes of transformer failure.

1) Over-voltage and Over-current
2) Reduced in oil level
3) Increased in transformer temperature
4) Poor maintenance and lack of monitoring of transformer by utilities.

Transformer is critical and expensive component therefore the precautions must be taken. Transformer which is of various size, type, and connection. Therefore the continuity of its operation is very importance in maintaining the authenticity of the power supply, An influence system is alleged to be faulty when an problem is occurs therein grid, here the unpleasant condition may well be short circuits, over-current, over-voltage etc. Any unintended repair work, mostly replacement of a faulty transformer, is incredibly expensive and time engross. Usually distribution transformer step down the voltage of 11kV to 440V. But faults and imprudently increase in load can cause the malfunction, insulation breakdown and complete failure of transformer which will cause the blackout. In this project a protection system has been designed in such a simplest way that system is monitored in real time, and these parameters are displayed on the application. within the application we will view the continual parametric information of transformer. during this investigation work a P.T is employed for step down the line voltage for measuring motive and for sensing the line currents a C.T is used. C.T is connected serial and P.T is connected in parallel to the terminals end of transformer. For sensing the temperature of the transformer we are using temperature sensor. For indicating the oil level we are using oil sensor which indicates the extent of oil.

1.1 REVIEW OF CONTROLLERS

In market at present there are currently various processing units availble from small controllers to large processors. In this project used of efficient controllers is demanded and good technical feasibility.according to the industries which need highly efficient processing unit for there control action and also the production process should fit in there industry standard.There are various controller available in the market out of which the two of the controllers which are mostly used for building prototype they are Arduino and Raspberry PI. A detailed comparison has been shown in the following table.

Table 2: Comparison of Controllers

Raspberry pi3	Arduino Uno/Node MCU
Stronger and quicker processor,multitasking available.	Easier to connect to Analog sensors, motors and other electronic components
Built in Ethernet port, Wi-Fi Bluetooth capability	Variety of shield that can add functionality
OS can be switched easily	Long Set-up not needed,just plugged in and the code will run.
Audio output, camera port ,USB ports, HDMI output all included.	Price is Cheaper and will not need much cables
Great for projects that need to connet online and have multiple activities going on at the same time.	Can run one code at time so can't multitask activities,slower speed.
Long set up and will need extra components when first starting .	No internet connectivity right out the box
Might need to install programs to get simple actions going	Bigger learning curve since it's C/C++ and will need to get outside sources to learn.
Can be more expensive	Can be cheap

From table as seen above the Raspberry Pi has more processing power and it is more efficient in processing information but as far as the budget has been concerned we are going to use Arduino UNO because it is easy to implement.we can also use arduino mega but we required only 32kb memroy and mega 256kb memory so we choose UNO.we can use code of UNO in mega and can run the system too. `

1.2 Review of Temperature Measuring Instruments

It has been seen that temperature monitoring of a system is mandatory consistent with the manufacturing of a product was caring there are various processes during which measurement 'of temperature is of utmost importance. A tiny low fluctuation in temperature can make the merchandise quality from better to worse.

This instruments are a deciding factor for safe and secure operation. Instruments like LM35, Thermistors, Thermo Couple have enormous demand within the market but just one out of these three will be choose we used LM35 in our project because it fulfill our requirements the detailed comparison of these three is shown within the table below.

Table -1: Comparison Between various instruments

Sensor Type	LM35	Thermistor	Thermocouple
Temperature Range	-55 to 150°C	-100 to 325°C	200 to 1750°C
Accuracy	-0.5 to 0.5°C	0,05 to1.5° C	0.5 to 5°C
Linearity	Linearly proportional	Exponential	Non linear
Power required	4 to 30V	Constant voltage or current	Self-powered
Response time	Fast 0.1 to 10 sec	Fast 0.1 to 10 sec	Fast 0.10 to 10 sec
Susceptibility to Electrical noise	Rarely susceptible	Rarely susceptible High resistance only	Susceptible/ Cold junction Compensation
Cost	Very low	Low to Moderate	Low

1.3 Review of communication model

After all the parameters sense by the sensors to transfer the data from sender to receiver. Various module are use to proces all the parameters and also to transfer the information at the receiver end. At the receiving end station we have created an application where all the parameters are listed and we can see the nature of the transformer.

Now the communication between the sender and receiver is the main factor, so for better system beside of using GSM we are using WiFi module which will transfer the information to applications where we can see all the parameters of the transformer. Communciation is most important part so the choosing of correct medium is important. There are two type of medium wired and wireless so going with the best technology we are using wireless technology. There are various module by means of which we can transfer the information such as SIM900A Modem, SIM800L Modem, ESP8266, nRF24L01 we are using ESP8266 WI-FI module for communication process.

2.LITERATURE SURVEY

i) Transformer wireless monitoring system using Arduino/XBEE by Amevi Acakpovi, Chiedozie, Issah B. Majeed, Nana Yaw

In this paper the author deal with design and construction of automatic monitoring system for power the transformer parameters he has implement a circuit, including ardunio and sensors to monitoring of instantaneous parameters of power transformer. He has implement the circuit successfully and shown the voltage vs current and voltage vs temperature.

ii) Design and implementation of real time transformer health monitoring system using GSM Technology by sajidur rahman, shimanta kumar dey, bikash kumar bhawmick and nipu kumar das.

In this paper authors have implements(THMS) Transformer health monitoring system using GSM module and single chip microcontroller which installed at distribution transformer and output of component are stored in memory for further requirement and they also applied protection system which followed predefined instruction in case of abnormality.

iii) Transformer health monitoring and control through Arduino by R.V PATIL, DHIRAJ KALANTRE, NIRANJAN HIRUGADE,ARUN MORE, ASHWINEE KAKADE

In this paper author has successfully exhibited the implementation of mobile embedded system to monitor and record key parameter of distribution transformer like load current oil level and ambient temperature in this method he used GSM modem for the purpose of online monitoring with the help of stand alone arduino and different different sensor.

3.PURPOSE METHOD

Basically there are various of method by which we can monitor transformer such as by using IOT , PIC 18 and other controllers but for IOT programming is quite hard to implement and for PIC 18 the software is changed so we where reliable with Arduino. And Arduino is cost effective controller and programming of Arduino is quite easy to understand and to implement too. Arduino is capable of fast communication and all the requirements are fulfilling by Arduino interested of using costly controller we use Arduino.

For monitoring of transformer we are using 12-0-12v or

15-0-15 500mA center tapped step down transformer. For sensing of current we are using ACS712 current sensor module (30A) which can sense up to 30A current flow there are other

sensor too like centlo, ktc but their rating are not matching with our specification so we use ACS712 as our CT current transformer. For sensing the voltage we are constructing a circuit which will sense the voltage level there are various voltage sensors but we tried to make a sensor of our specification.

For sensing the temperature of transformer we are using LM35 which sense the temperature from -50°C to +150°C we can also use thermistor beside of LM35 but LM35 not required external calibration and LM35 get less self-heated up to 0.08°C but thermistor get too heated due to that readings are not mostly accurate (From paper 1) We are using 1 channel 5V relay for turn ON-OFF flow of current which having specification of Operating Voltage 5V, Max Current : 20mA there are some different relay such as Grove relay, Grove spdt relay but they having more cost and we are trying to make cost efficient model.

To sense the moisture of transformer we are using soil hyprometer moisture detection water sensor module YL-69 sensor HC-38 module arduino which is dual output mode, digital output, analog output more accurate which operates at Operating voltage -3.3v to 5v. For communication process we are using ESP8266 Serial WI-FI Wireless Transceiver Module which is self-contained single core 32 bit L106 & it's typical frequency is 80mhz it had 10 bit adc it has 10 channel software pwm with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network we can also use ESP32 but it has 16 channel with a frequency of 160mhz and it has inbuilt Bluetooth ESP8266 not have a Bluetooth for our project there is no requirement of Bluetooth so we use ESP8266(From paper 2).

And the main part to control and to connect the all the components and sensors we are using Arduino UNO as a controller which operates at Operating Voltage: 5V, Input Voltage: 7-12V, DC Current: 40mA, Flash memory 32 kb. We can also use mega which have rating of Input Voltage (recommended): 7-12V, Input Voltage (limits): 6-20V, DC Current: 40 mA, Flash Memory: 256 KB but our requirements is fulfilled by 32kb and UNO is cost effective than mega so we use UNO but the programming of the both UNO and mega is same we can use programming of UNO in mega and can implement the project (From paper 4).

4.EXPECTED RESULTS

CT and PT are used for detection of over-current and over-voltage respectively hence these will detect any reasonably condition occurs and display it on application API (Application programming interface) and also instructs relay to disconnect load. LM35 is employed as temperature sensor which detects transformer temperature. By means of hyprometer moisture sensor we will determine oil level of the transformer. To work out the status of the transformer we are using ESP8266 Serial WI-FI Wireless Transceiver Module is use to transmit the info and it'll display the all parameters on the application.

5.CONCLUSION

In this paper, we see the way to design and also the build of a microcontroller-based system which is capable of monitoring over-voltage, over-current and temperature of a transformer, oil level of the transformer and the way we will create application by use of API (Application programming interface). The ESP8266 modules is employed to transfer data from one point to a different. This method helps the officers to do maintenance of transformer in real time. The time delay for transfer data between the transmitter and also the receiver is lesser than a second. This makes the system very reliable and efficient. With modern technology it's possible to monitor an oversized number of parameters of distributed transformer at a comparatively high cost. The challenge is to balance the functions of the monitoring system with its cost and reliability. Application base monitoring is kind of helpful than manual monitoring.

6. REFERENCE

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