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Transformer Oil Temperature Monitoring with GSM Based Fault Detection

Venkatesh Patil, Ganesh Satras, Mukund Pawar, Ranjitkumar Biradar

Abstract*: Transformer is an important and costly device in the power system. The reliable and fault free operation of a decisive role in the availability of electricity. The ageing of transformer depends on several factors especially electrical and thermal stresses. Due to which incipient faults occurs which in turn if left undetected will cause deterioration and eventually lead to failure of the transformer. The presence of faults in transformer results in chemical decomposition of the transformer oil. The transformer oil is deteriorated due to the combination of the ageing process such as partial discharge (PD), electrical arcing and thermal ageing. But some faults occurs in the substation that faults are affect the transformer operation as well as transformer life. These faults are short circuit and open circuit faults. In this project, we will attempt to show that how to avoid such electrical equipment failures could be caused by temperature rise in transformer and short circuit, Open circuit in substation.

Keywords: AVR Microcontroller, LM35 Temperature Sensor, GSM Module Etc.

I. INTRODUCTION

New modern electronic technologies motivate the creation of new generation of transformers as intelligent devices for advanced distribution automation in future. The Power transformer is essential equipment of the Electrical power system. Usually power transformers have a 20-35 year design life. In practice, a transformer can reach 60 years of useful life if it is properly operated and maintained. With the normal aging, their internal condition degrades, which increases the risk of failure. Traditionally, the evolution of these faults was accompanied with preventative maintenance programs combined with regular tests. With deregulation, it has become necessary to reduce maintenance costs and equipment inventories, thus there is a trend in the industry to move from traditional time-based maintenance programs to condition based maintenance.

This paper presents a monitoring system for safe operation of transformers. The equipment is permanently mounted on the transformer and is online. The system is modular and expandable for additional requirements that may be needed in future. The ultimate objective is to monitor the transformer oil temperature as well as display a temperature of transformer oil and to inform the short circuit, open circuit fault to the concerned official authorized person.

A. Objectives:

- Continuous oil temperature reading of one or more transformer.
- LCD display based visual alerts and continuous monitoring.
- Reliable for industrial needs.
- GSM ,SMS based alerts

II. BLOCK DIAGRAM

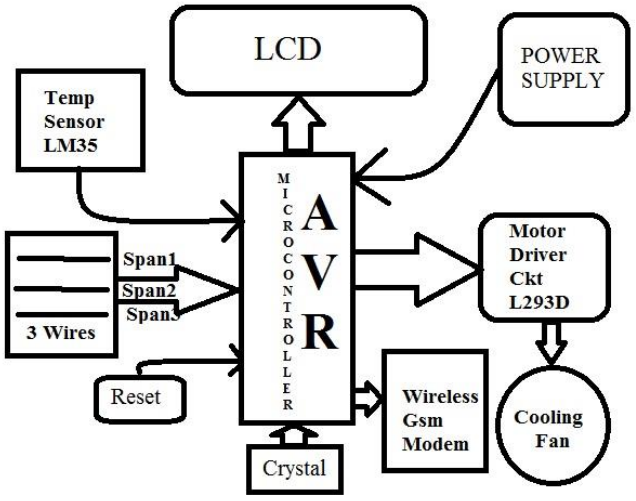

Figure 1. Block Diagram

Figure 1 shows the schematic block diagram of transformer oil temperature monitoring. When the power supply is connected to the circuit the power supply is converted 230V AC into the 12 V DC. The power supply is directly connected to the AVR Microcontroller. The LM35 Temperature sensor is connected to the transformer. It has a 3 Pin IC Vcc, GND, and Out. In this the Vcc is connected to the power supply, GND is connected to the Ground terminal of microcontroller and Out pin is connected to the Microcontroller of output pin. The LM35 sense the temperature of transformer and it transmit the data in analog form to microcontroller. The LCD is a 16x2 LCD Display it has a 14 pin Vss, VDD, VEE, R\W, RS, E and 8 Data pin.

This LCD shows the temperature of transformer. The motor drive IC L293D IC. This IC is use for drive the fan. This is 16 pin IC. This can drive the two motor at a time. These two motor is connected to the 3, 6 and 11, 14, pin 4, 5and 12, 13 are the connected to ground. Pin 2, 7 and 10, 15 is connected to the microcontroller.

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Pin 1 and 9 is Enable pin. Pin 8 is connected to 16V supply and pin 16 is connected to the 5V supply.

The additional feature of this project is GSM Based fault detection the 3 wire span is connected to the 3 phase supply and these connection gives to the microcontroller. If the fault occur in the system the span sensor are sense and send signal to the microcontroller then then the microcontroller send the command to the GSM module. And GSM module send SMS to the Official authorized person.

III. COMPONENTS

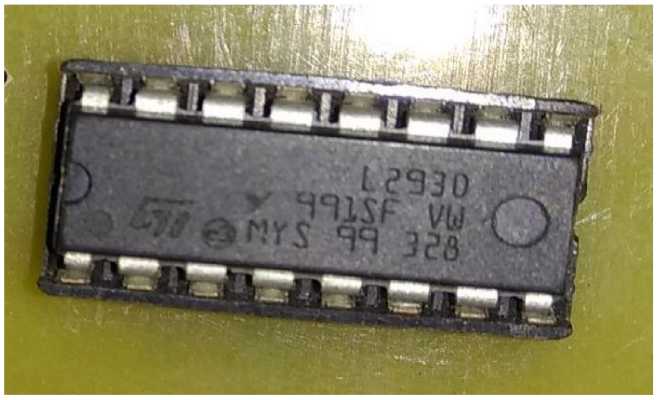
A. Microcontroller:

As mentioned earlier microcontroller is the heart of this circuit. The microcontroller used in this project is IC P89V51 of Philips. It is from 8051 family. This microcontroller contains 512/1024 bytes of RAM, 64K bytes of on-chip ROM, two timers, one serial port and four ports(each 8bits wide) all on a single chip. The Mux Seven Segment Display is connected to the Port 2. The transistor is connected to port 0. The Keys are connected to the port 1. The keys are connected in sinking mode means when the keys is pressed the active low pulse i.e. Logic '0' goes to the controller. An external memory is also connected to microcontroller using the same port P 0.0 and P 0.1. Port 3 is used for serial communication. Pin 10 and 11 of MAX232 is connected to P 3.0(RxD) and P 3.1(TxD) respectively which is used to voltage conversion. MAX232 is used for converting RS232 voltage levels to TTL and Vice Versa 3.2(INTO) and P 3.3(INT1) is connected to RS232. XTAL1 and XTAL2 are connected to a crystal of frequency 11.0952 MHz if security bit 1 is programmed, EA will be internally latched on Reset. In our circuit, we have kept it low because an external memory is connected to the microcontroller.

Pic- AVR Microcontroller

B. Motor Driver (L2930D IC):

L293D IC generally comes as a standard 16-pin DIP (dual-in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins (if you do not use enable pins).



Pic- Motor Driver (L2930)

1. Truth Table:

How do we control the direction of these motors? Let us take an example: Suppose you need to control the left motor which is connected to Pin3 (O1) and Pin6 (O2). As mentioned above, we require three pins to control this motor - Pin1 (E1), Pin2 (I1) and Pin7 (I2). Here is the truth table representing the functionality of this motor driver.

Table 1 Truth Table of Motor Drive Operation

Pin 1	Pin 2	Pin 7	Function
High	High	Low	Turn Anti-clockwise (Reverse)
High	Low	High	Turn clockwise (Forward)
High	High	High	Stop
High	Low	Low	Stop
Low	X	X	Stop

C. Temperature Sensor (LM35):

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in °Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼ C at room temperature and ±¾ °C over a full 55°C to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 draws only 60 µA from the supply, it has very low self-heating of less than 0.1° C in still air.

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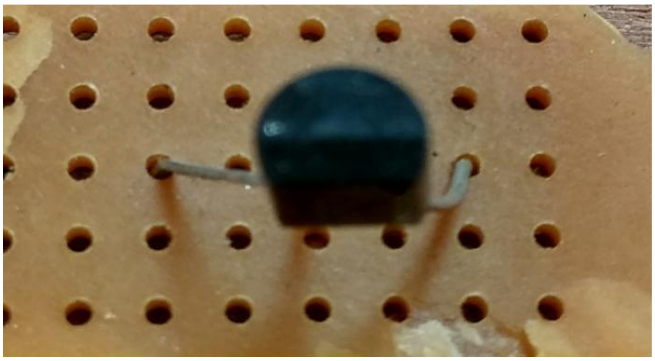


Pic- Temperature Sensor (LM35)

D. Liquid Crystal Displays (LCD):

An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller (the black blob on the back of the board). This controller is standard across many displays (HD 44780) which means many micro-controllers (including the Arduino) have libraries that make displaying messages as easy as a single line of code Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16x2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

Pic- LCD Display

E. GSM:

GSM (Global System for Mobile communications: originally from Group Special Mobile) is the most popular standard for mobile phones in the world. Its promoter, the GSM association, estimates that 80% of the global mobile market uses the standard. GSM is used by over 3 billion people across more than 212 countries and territories. Its ubiquity makes international roaming very common between mobile phone operator, enabling subscribers to use their phones in many parts of the world. GSM differs from its predecessors in that both signaling and speech channels are digital and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system.

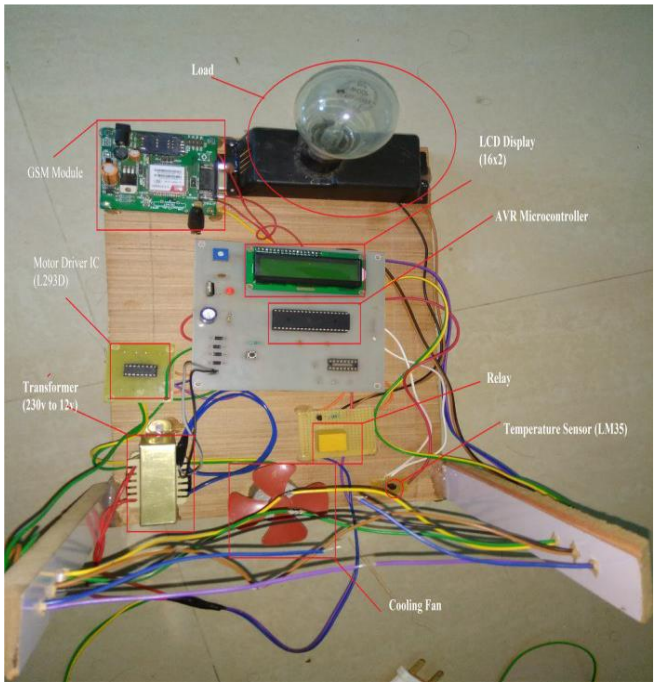
Pic- GSM Module

F. Cooling Fan:

Fan is used for the cooling the transformer temperature. The Transformer Air Forced Cooling is used in our project. By using fan we can maintain the transformer temperature.

Pic- Fan

IV. PROJECT PHOTO



Pic- 1. Overall View of Project

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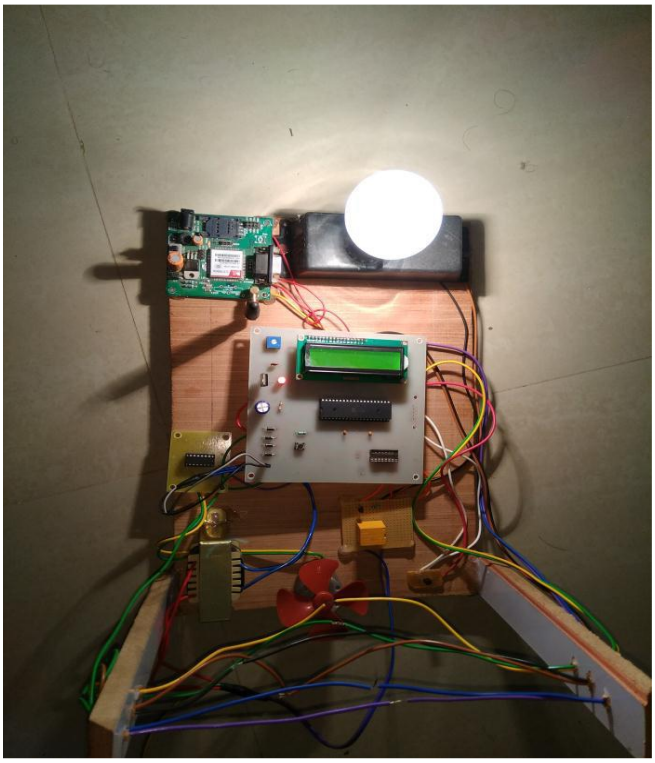


Pic-2.System is in Running

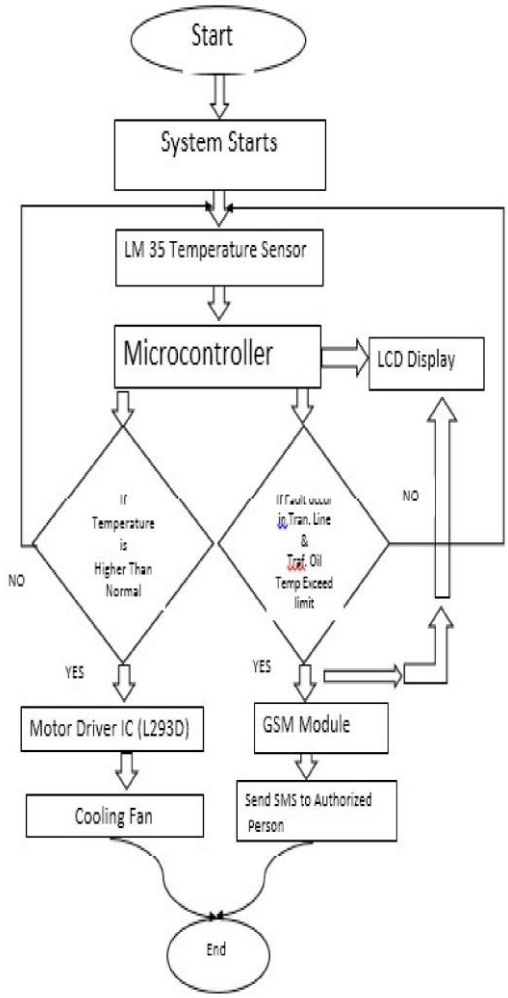
Pic-3.At the Staring Normal Temperature Shows

Pic-4.When the Open Circuit Fault Occur

Pic-5. When the Short Circuit Fault Occur

Pic-6.After the Fault Occurred The System Sent SMS To Authorized Person.

V. FLOWCHART



Pic-7. Flowchart of Overall Operation

VI. RESULT

Our project is based on the GSM Module. When the Fault occur in the Transmission line then Microcontroller send the signal send to the GSM and GSM send signal to the Authorized person.

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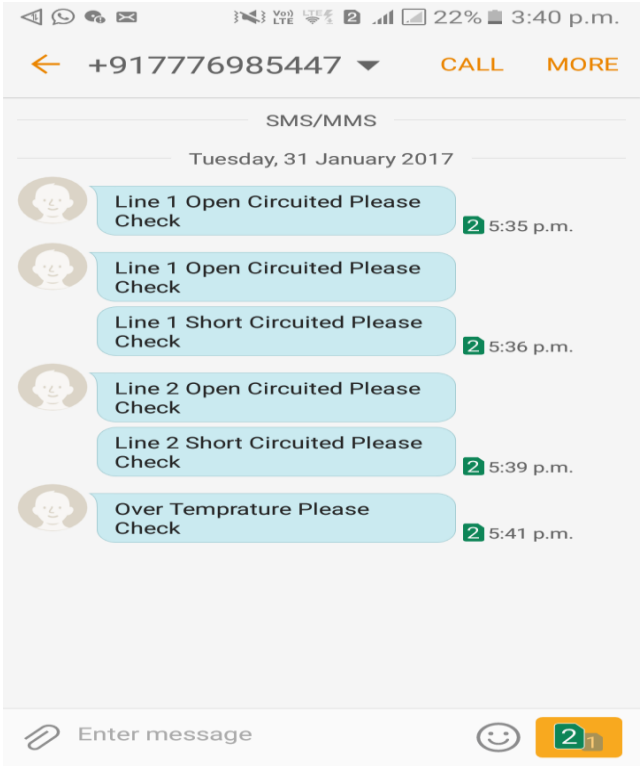

Pic-7. The Result

VII. CONCLUSION

Transformer diagnostics is an expanding field of study. The monitoring system presented in this paper can be altered and expanded to provide more and more valuable information on the health of a transformer. The potential of this system is vast and with further investigation, the concept of an intelligent diagnostic for transformer or even substation level can be realized. The result of this paper, which is designed for monitoring essential parameters of the transformer, shows great promise on being a successful monitoring system for high voltage transformers. The proposed design of the system makes the distribution transformer more robust against some key power quality issues which makes the voltage, current or temperature to peak. Hence the distribution is made more secure, reliable and efficient by means of the proposed system.

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