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Automatic Cooling System Control and Performance Enhancement of Generating Transformer

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ABSTRACT: In this paper, the main objective is to control the cooling system of generating transformer automatically and to increase its efficiency. A Peripheral Interface Controller (PIC) is used to control the transformer's cooling system instead of Programmable Logic Controller (PLC). For monitoring the temperature rise in winding and oil, temperature sensors are embedded in winding and oil. When the temperature rise of winding and oil exceeds the limit, the fan (Forced Air Cooling) and oil pump (Forced Oil Cooling) will be operated. To monitoring the healthiness of pump, Voltage divider and current sensor are used. And in this paper, mobile application is included as additional feature which is used to monitoring the cooling system's parameters (Temperature, Pump's Voltage and Pump's current) through ESP 12 as Wi-Fi module. By using Proteus software, the proposed method is simulated.

KEYWORDS: Generating Transformer, PIC (Peripheral Interface Controller) microcontroller, Temperature sensor, Ultrasonic sensor, ESP12(Wi-Fi module).

I.INTRODUCTION

In recent days, industries are shifting towards automation. Two major components of industrial automation are programmable controllers and robots. These components are performing intelligent operations. These intelligent operations are used to minimize the manual work and improve the efficiency of industrial systems.In power transmission, Transformer is a static and efficient device which is used to intensify and step down the voltage performing on the principle of electromagnetic induction. If any problem occurs on transformer, compensating that problem will be difficult. There are many faults occurring in this device such as faults in winding, core etc. As we have skilled industrial visit, we have acknowledged number of problems. Problems such as increasing winding temperature, winding short circuit fault, fault in pump etc. At present air cooling, water cooling, oil and water cooling system are used to reduce and maintain the winding temperature. Use of timers, contactors in control instruments panel makes it very complicated and expensive. By using PIC (Peripheral Interface Controller) micro controller, these complications will be reduced.

II.LITERATURE SURVEY

Previous and current cooling system contactors, relays and timers were used for this cooling system process. For automatic control of various cooling system's components such as fan, pump, switches etc., and sequential logical operations, PLC, AVR based microcontroller chip of 8-bit ATmeg(L) and ATmega (Arduino Platform) were used. For measuring the temperature rise in winding and oil, WTI (Winding Temperature Indictor) and OTI (Oil Temperature Indicator) were used. In these control systems, buzzer will be indicated as a system is reached certain level of temperature and then fan and oil pump will operate if temperature exceeds the permissible amount of temperature. For monitoring measured data from some other place, DCS (Distributed Control System) was used through cables.

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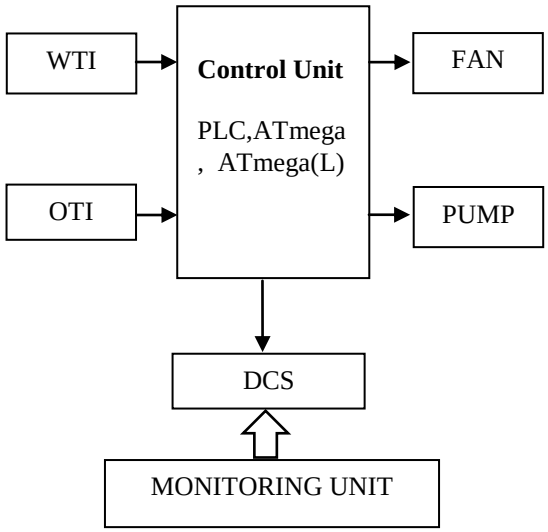

Fig1.Block diagram of Existing System

USAGE OF EXISTING SYSTEM'S COMPONENTS

- **WTI** : Temperature sensor
- **OTI** : Temperature sensor
- **FAN** : Forced Air Cooling
- **PUMP** : Forced Oil Cooling
- **DCS** : Transmits Data by cables
- **MONITORING UNIT** : Monitoring collected data
- **CONTOLUNIT** : Control the cooling System

DRAWBACKS

- Monitoring the measured data through cables only.
- Usage of timer and contactor in cooling instrument panel makes it complicated.

III.PROPOSED SYSTEM

Drawback of existing system is compensated in this proposed system. i.e., Collected or measured data will be monitored through mobile application by ESP12 as Wi-Fi module.

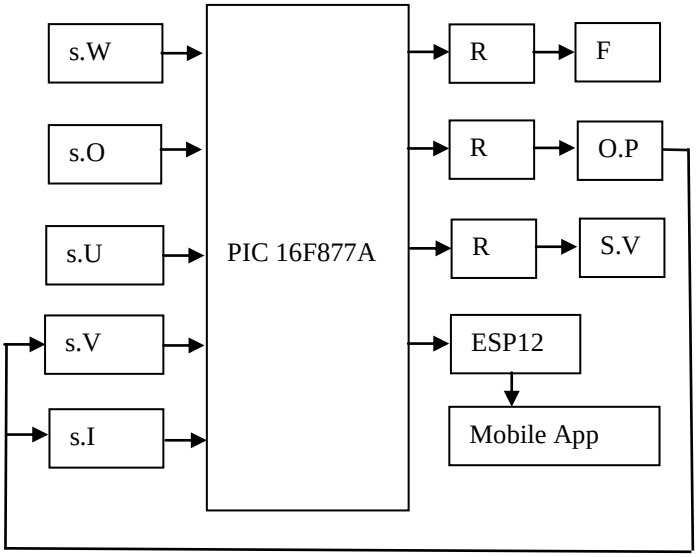

Fig2.Block diagram of Proposed System

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BLOCK DIAGRAM DESCRIPTION

- **s.W** : Temperature sensor(*W)
- **s.O** : Temperature sensor(*O)
- **s.U** : Ultrasonic sensor
- **s.V** : Voltage Sensor(*VD)
- **s.I** : Current Sensor
- **R** : Relay
- **F** : Fan
- **O.P** : Oil Pump
- **S.V** : Solenoid Valve
- **ESP12** : Wi-Fi module
- **Mobile APP** : Blynk application
- **PIC16f877a** : Peripheral InterfaceController

***W** :Winding
***O** :Oil
***VD** :Voltage Divider

IV.SYSTEM DECRIPTION

PERIPHERALINTERFACECONTROLLER (PIC)

In this proposed method, PIC microcontroller is used to control and monitoring the cooling system of generating transformer. By using this controller, interfacing hardware and software to the system are easy. And for this microcontroller, supporting hardware and software are easily available.For industrial purpose, this PIC microcontroller is extensively used.

This PIC microcontroller consumes lower power and operating at high performance. Its operating frequency is 50MHz.

TEMPERATURE SENSOR (WINDING AND OIL)

LM35 – Temperature measuring sensor. This sensor used to measure the temperature rise in winding and oil. It acquires low self-heating capacity. It shows values within the sort of output voltage rather than degree Celsius. That output voltage is proportional to the Celsius temperature.

ULTRASONIC SENSOR (US)

To monitor and determine the level of oil in transformer tank, this sensing unit (Ultrasonic sensor) is used. It transmits the sound pulse to the oil surface then that signal is reflected back to the sensor. That reflected signal is proportional to the oil level.

VOLTAGE SENSOR(V)

Voltage divider is used as voltage sensor. To monitoring the healthiness of pump, this voltage sensor is used. A potential divider may be a simple circuit which turns an outsized voltage into a smaller one. We will create an output voltage that's a fraction of the input. Voltage dividers are one among the foremost fundamental circuits in electronics.

CURRENT SENSOR(I)

ACS712 current sensor is that the sensor which will be able to measure and calculate the quantity of current applied to the conductor without affecting the performance of the system. This sensor is also used for monitoring the healthiness of pump. ACS712 current sensor may be a fully integrated. Hall Effect based linear sensor IC.

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ESP12

ESP12 unit is an additional feature of this proposed system. It makes connection between hardware prototype and mobile application. ESP12is a miniature WI-FI module which is used for establishing a wireless network connection for micro controller. It is used for data sharing. It is lowest cost solution for developing IOT application. By using this ESP12, measured data will be monitoring in mobile application.

BLYNK APPLICATION

This is the wireless mobile application. Which is used for monitoring the cooling system parameters such as winding temperature, oil temperature, pump's voltage and pump's current through Wi-Fi module.

V.WORKING

Temperature sensor (Winding and Oil), Ultrasonic sensor, Voltage sensor and Current sensor, which are input parameters. Fan (Forced Air Cooling), Oil pump (Forced Oil Cooling), Solenoid valve and Wi-Fi module, which are output parameters. These input and output parameters are interfaced with Generating Transformer by using PIC (Peripheral Interface Controller) microcontroller. Temperature sensor is embedded with winding and oil, which is used measure the temperature rise in winding and oil continuously. That measured data will be transferred to PIC microcontroller. Then microcontroller send the command signal to the fan and oil pump. When temperature rise in winding and oil reaches certain level, buzzer will be indicated. Fan and Oil pump will be turned on if
the temperature rise exceeds the permissible level of temperature. Relay trips the circuit if the oil temperature exceeds 85^0C. Oil level in tank is also monitored continuously by ultrasonic sensor. When oil level is decreased in tank, it will be filled automatically from storage tank through solenoid valve. To measure the healthiness of pump, pump's voltage and current are given as input to controller, which is compared with reference value. These parameters are monitored by mobile blynk application through Wi-Fi module (ESp12)

VI.SIMULATION

For this proposed system, simulation is included as follows.Proteus software is used for simulating this method.In this proposed system's simulation, only one temperature sensor is used for both winding and oil.

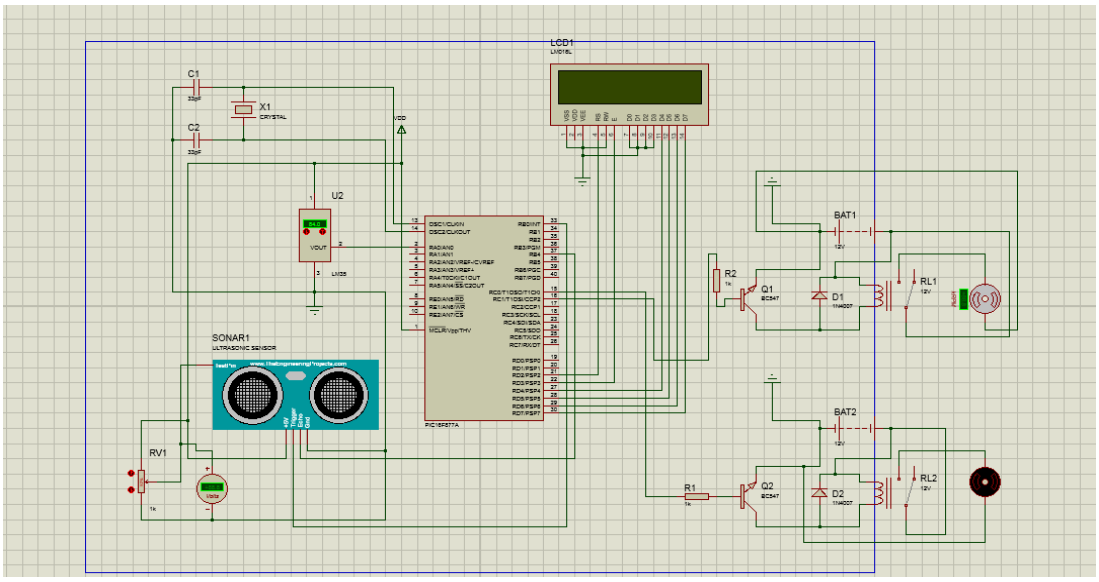

Fig3. Circuit diagram

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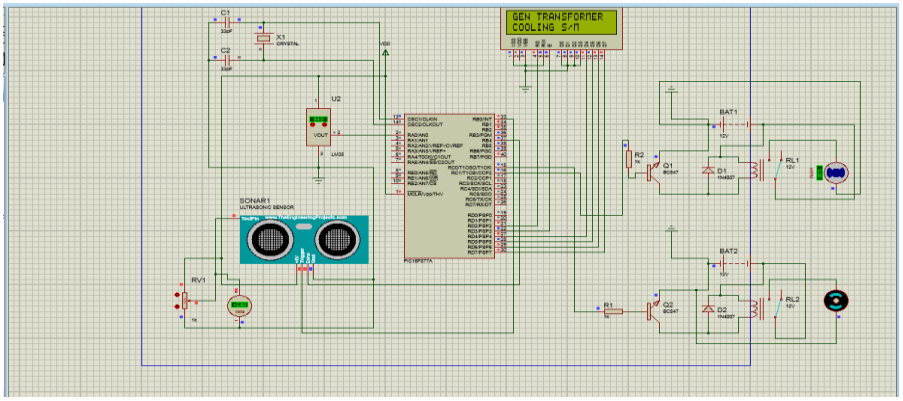

Fig4. Simulation result

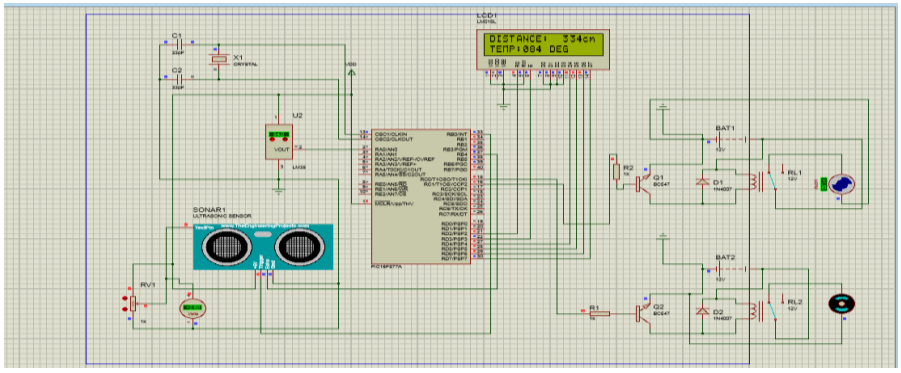

Fig5. Simulation result of temperature sensor and ultrasonic sensor on LCD

VII.CONCLUSION

The way of transformer cooling system control has direct effect on its thermal performance. So, operating conditions of transformer can be optimized by effective control of cooling system. In this project, we have used PIC microcontroller to control the cooling system of transformer. By using this PIC (Peripheral Interface Controller) microcontroller, wecaninterface both hardware and software with system easily. Economic wise also is convenient.

VIII.FUTURE SCOPE

In future, cooling system of generating transformer will be monitored and can controlled from some other places through IOT (Internet of Things).

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