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Performance Monitoring of Transformer Parameters

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Abstract: Transformers are basic design of electrical device which provide power transmission by transforming induced current from one circuit to another. They have complexity in measuring and monitoring the electrical parameters manually. A system is proposed to measure the parameters using sensors and take the corrective measures when there is a malfunctioning in the system. The real time controlling is done on the basic features like gas level, oil level. These features are essential for effective power transmission and long life of industrial transformers. The monitoring and control of the transformer is done by using PIC microcontroller, RF transmission for wireless communication and sensors which check the level of gas, and oil. The design is to sense the features of transformer and send the information regularly to the controller, the controller in turn will makes the transmission through RF to the client. So, this design makes possible to attain real time control and monitoring of parameters.

Key words: Gas Level, Oil Ageing, Wireless Communication, Microcontroller.

I. INTRODUCTION

In electrical power transmission systems, transformers represent one of the key components in utility systems. Since, it is an integral part of the substation, strategic bottle necks occur if we fail to monitor the transformer. This can allow for a change from periodic to condition-based maintenance. Some parameters of the transformer operation are (1) Temperature of oil, (2) Moisture level, (3) Level of floats, (4) Operation of cooling fans, (5) Electrical load levels and (6) Gas sensors. This study shows the real time monitoring and control of systems using sensors for reading the value of different parameters of transformers.

The reason for using PIC microcontroller devices are cost effectiveness, small size, robust and reduced power consumption which helps in the use of minimum power. So the basic features of PIC can be used for an industrial application like controlling of transformers in a real time. The RF communication needs a base band controller which will provide a wireless mode of communication between a monitoring embedded device and the client by instant messaging about transformers features in regular intervals.

General faults in a transformer can be grouped as (1) Mechanical (2) Contacts erosion and (3) Contact choking leading to high resistance and overheating. In order to reduce some internal failures like risk of fire and explosions, several standards and protective devices have been installed. There are several parameters which will affect the working of the transformer. The four main parameters that are mainly concerned here are gas, temperature, overload and oil. Inside a transformer, formation of many gases takes place. They are listed as: Atmospheric gases: Hydrogen, Oxygen, Nitrogen; Oxides of carbon: Carbon monoxide and carbon dioxide; Hydro carbons: Acetylene, methane, ethane. Formation of gas inside the transformer is a major problem which is formed due to decomposition of oil, insulation overheating, corona, arcing of the transformer etc; all this change of information will be continuously sensed by the gas sensor and sent to the microcontroller and this will be intimated to the operator thereby it automatically switch on the exhaust fan.

The paper is organized as follows: section 1 deals with introduction, section 2 explains the block diagram of the system, section 3 explains the evaluation methodology and section 4 concludes the paper.

II. BLOCK DIAGRAM

A. PROPOSED SYSTEM

The existing transformers have complexity in measuring and controlling the parameters manually. The occurrence of fault in the transformer requires time for monitoring and rectifying. Due to this, there occur delay in the process and efficiency get reduces. To overcome these difficulties, the system is digitalized and the parameters are measured using sensors and corrective measures are done automatically.

In this system, PIC16f877A microcontroller is used .The transformer parameters such as gas and oil level is monitored. The sensoring unit is used to sense the transformer for these two parameters. The measuring unit consists of gas sensor and oil sensor which sends the analog value to the microcontroller unit. The microcontroller unit performs the necessary control actions like switching on the exhaust fan.

The RF transmitter does the transmitting action to the place where it can be viewed. The RF receiver is connected to the LCD display for monitoring the parameters. Thereby, the transformer is monitored continuously for a regular operation. The block diagram of the system is shown in figure 1.

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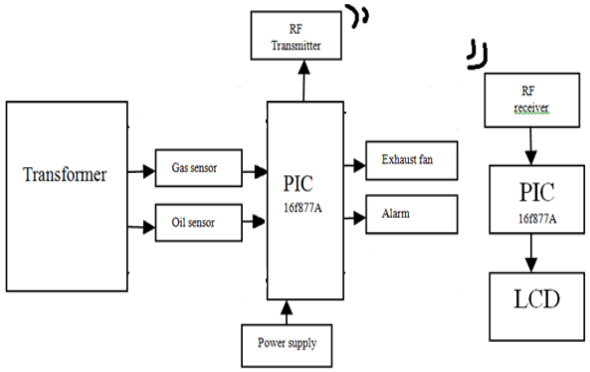

Figure 1: Block diagram of the system

B. Transformer parameters

The transformer is monitored regularly so that it enables to have a continuous operation in the system. It is analyzed for two parameter such as oil level and gas level. If these two parameters have a fall in their value the functionality of the transformer will be cut off.

Gas Sensor

The gas sensor MQ2 is a SnO2 based gas sensor which can sense gases like methane, propane, butane, alcohol, smoke, hydrogen etc. Since LPG primarily contains propane and butane, MQ2 sensor can be used for sensing LPG. The figure 2 shows the schematic of an MQ2 gas sensor.MQ2 sensor senses the flammable gases by the increase in temperature when they are oxidized by the heating element. Consider the figure given above. If there is any flammable gas present in the sample, the oxidization of the same gas results in increased temperature and the resistance of the sensor resistor will drop. That means more current will flow through the load resistor and so the voltage across it will shoot up.
At normal conditions (no LPG in the air), the sensor resistor will be very high around 850 K. So the voltage drop Out across the load resistor will be around zero. When the sensor is fully exposed to LPG the sensor resistance drops to around 800 ohms and the voltage drop across the load resistance will be around 4.62 volts.

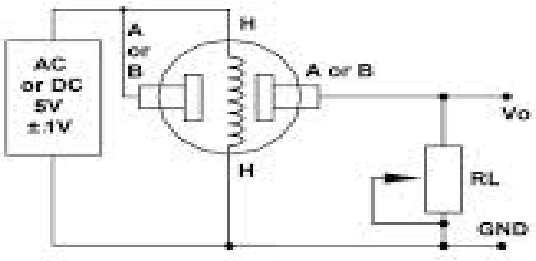

Figure 2: Gas Sensor

Oil Sensor

Oil level sensors are used to indicate the reduction in the oil level of the transformer. It is used to indicate the point-level detection of a wide range of conductive liquids such as water and it can be used for highly corrosive liquids. The sensor's electrodes need to be constructed from titanium, Hastelloy B or C, or 316 stainless steel and insulated with spacers, separators or holders of ceramic, polyethylene and Teflon-based materials. Depending on their design, you can use multiple electrodes of differing lengths with one holder. Since corrosive liquids become more aggressive as temperature and pressure increase, consider these extreme conditions when specifying these sensors.

They are extremely safe because they use low voltages and currents. Since the current and voltage used is inherently small, for personal safety reasons, the technique also is capable of being made "intrinsically safe" to meet international standards for hazardous conditions. It is very simple for installation purpose. It will be conductive in nature.

III.SIMULATION RESULTS

The simulation result for gas sensor and oil sensor is shown in figure 3 and 4.The gas sensor is used to sense all types of gases emitted from the device. The transformer is monitored for two parameters such as oil and gas. If the level of oil and gas in the transformer goes low below the specified value, then the monitoring unit sends the information to the controlling unit. The transformer is protected with the help of sensors which are installed in the system.

The sensoring unit protects the transformer .The data from the controlling unit is transmitted through RF transmitter. The RF receiver receives the transmitted information and displays in the LCD through the microcontroller. Through this system, the transformer is monitored on regular basis for an efficient operation.

The simulation is done on PROTEUS v7.7 for the regular monitoring of the transformer. The circuit is simulated, the standard value of oil level and gas level is specified and on running the system if the value is below the required level ,the indication is shown and the necessary action steps is taken.

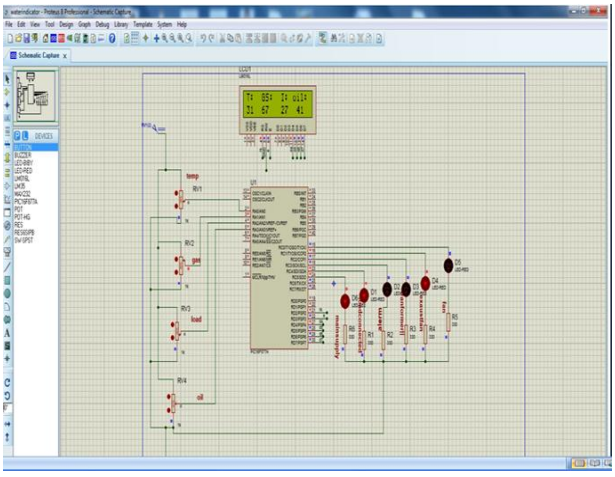

Figure 3: Simulation Result of Gas Sensor

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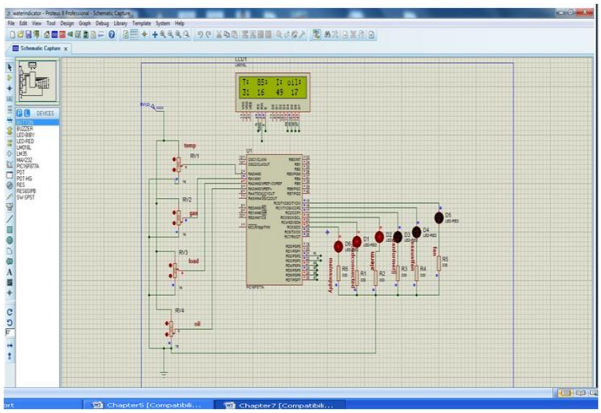

Figure 4: Simulation Result of Oil Sensor

IV. CONCLUSION

This project focuses on monitoring and controlling the transformer using sensors and RF transceiver circuit. In most of the industries mainly transformer life decreases due to improper maintenance and manual operation. If every industry installs the proposed system transformer controlling and maintaining can be made easier. Proposed system is a micro controller based wireless system. PIC micro controller is used because of its low cost and high efficiency. It provides an effective measure to save man power by providing automation of transformer monitoring and controlling.

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