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TRANSFORMER MONITORING BY USING MICROCONTROLLER

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Abstract

Technology is growing at a very faster rate. The recent development in sensor and computer technology allows the application of on-line monitoring systems of power transformers. This new technology should be used in optimum and economic manner. It means the overload and life capacity of the transformer can be controlled. An early warning should be given by the system of an oncoming insulation fault. Nowadays automation has become a basic need which is required for precise and accurate operation. In this project a microcontroller based system is designed that can be used in power transformer protection. The main objective of this project is to monitor the load. The power transformer is one of the most significant equipment in the electric power system and thus its protection is very important. With the increase in demand of power, the existing systems may become overloaded. The overloading can affect its efficiency and protection systems. To prevent damaging of transformer due to overloading, it is necessary to control it against over current tripping. During monitoring of any parameter of the transformer, the latest technology of micro controller and relays can be used. Microcontroller finds its application in each and every automation operation. The project described here being also a microcontroller based project. The use of microcontroller in this project is to store the data, process data and change data according to the user requirement.

Index Terms: *Microcontroller, Relay, Transformer, Current Sensors, LCD display, over current, Current Tripping.*

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1. INTRODUCTION

Protection against fault in power systems is very important. A power system is said to be faulty when an undesirable condition occurs in that power system such as short circuits, over current, overvoltage etc. The system is designed in such a way that it can measure the parameter i.e. current flowing through the transformer through the current sensors. A LCD display is used to show system current readings. If the current flowing through any of the circuits is above the fixed levels then it will display it on the LCD display. Thus the system is able to detect currents above the normal operating level. Thus, there is a need to either reduce the load immediately or isolate the power transformer from the distribution line. This isolation process is to ensure that the transformer is safe from any excess current levels. Higher current levels can cause overheating and thus damage it .To warn an operator of a fault occurrence, LEDs and a piezoelectric buzzer have been used. If the current levels are high then it will turn on the buzzer. The LED of the respective grid which is faulty will blow off.

If the load is not reduced in specific time the microcontroller will send signals to drive the relays through relay drivers. The relays connected in the circuit will trip the faulty circuit thereby protecting the transformer. In this way a simple monitoring system can be designed using micro controller. This is possible because microcontroller has CPU, memory, I/O ports, timers, ADC/DAC, serial ports, interrupt logic, and many more functional blocks on single chip. Hence it reduces the cost of hardware. Also there is no need to connect external RAM for memory storage. The examples are Intel MCS-51, PIC family by microchip, ATMEL 89CXX, 89CXX51. The microcontroller used for this project is ATMEL-89C52. The purpose of power system protection is to detect faults or abnormal operating conditions and thus send signals to relay drivers. The relay drivers will switch on the relays. Obviously, a relay cannot prevent the fault. Its purpose is to detect the fault and trip the respective circuit if the load is not reduced in time to protect the transformer. For the past several years fuse, circuit breakers and electromechanical relays were used for the protection of power systems. But these have some drawbacks.

Therefore some research was conducted on relay which can be connected to microprocessors in order to eliminate the drawbacks of the traditional protective techniques. A microcontroller based transformer overload protection is developed as the microprocessors based relays provides greater flexibility, more adjustable characteristics, increased range of setting, high accuracy, reduced size, lower costs along with many functions such as control logic, event recording, fault location data, remote setting and self-monitoring.

2. METHODOLOGY

An innovative design can be developed for a system based on micro controller that is used for monitoring the voltage, current and temperature of a distribution transformer in a substation. It can be used to protect the system from the rise in mentioned parameters. Providing the protection to the distribution transformer can be done by shutting down the entire unit. In general, the design is developed for the user to easily recognize the distribution transformer that is suffered by any open or short circuit and over current conditions. The objective is to monitor the electrical parameters continuously and hence to guard the burning of distribution transformer or power transformer due to the constraints such as overload, over temperature and input high voltage. If any of these values increases beyond the limit then the entire unit is shut down by the designed controlling unit [2].

Transformers are very important components of the electric power transmission and distribution infrastructure. The transformers must be monitored on regular basis to prevent any potential faults. Failure in transformer can easily cost several million dollars to either repair or replace. It will also cause a loss of service to customer's revenue until the problem is found and repaired. In the past, many techniques have been proposed for the protection of transformers. But all those systems were lacking in providing a robust and reliable which could maintain the transformers and provide protection. Hence automation of the transformer using microcontroller was introduced. Various parameters such as temperature, current and oil level of the transformer are monitored. Any abnormal condition causes the microcontroller to trip the relay and the cause for increase in temperature is also displayed. Thus the transformer is protected from severe damage [1].

3. ARCHITECTURE

The architecture of the transformer monitoring system with microcontroller and relays is shown in Fig -1

Figure 1 consists of following components:-

- Power Supply
- Current Transformer
- Current Sensor
- Microcontroller
- LCD Display
- ULN Driver 2803
- Buzzer
- Relay
- ADC 0809

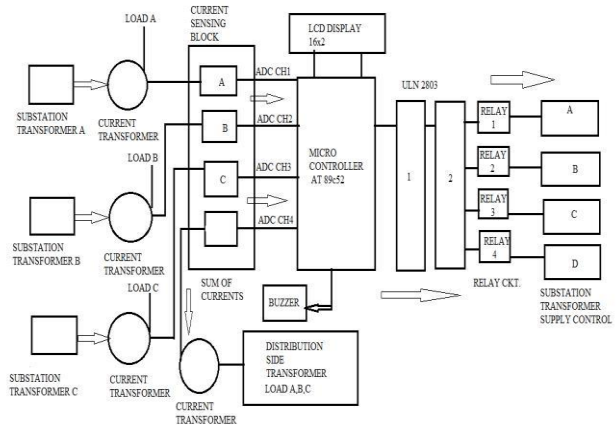

Fig-1: Transformer Monitoring Using Microcontroller and relay circuits

The function of each of the components can be discussed as follows:-

3.1 Power Supply

The power supply circuit design is one of the important parts of this project. Without a power supply the electronic devices such as microcontroller, relay, alarm, LCD display will not function. Similarly a wrong power supply design will lead to the damaging of the electronic devices used in this project. The main power supply needed for this project is 5V DC to power on the relay and other electronic devices such as microcontroller etc.

3.2 Current Sensor

The measurements can be dangerous and very difficult if the actual load and fault currents are very large. Thus, current sensors are used. The current sensor is capable of measuring up to 50A. The monitored current values are displayed on the LCD display. As soon as the over current limits are sensed by the sensor the microcontroller sends the signal to relay and protects the transformer by tripping the circuit carrying excess current.

3.3 Microcontroller

In this project, microcontroller 89c52 is used. This controls all the functions of project. The microcontroller gets the signal from the current sensor of over current in the circuit.
Then it triggers the relay to trip the circuit along with alarm. The microcontroller is required to serve the purpose monitoring the transformer information such as temperature, voltage and current through the LCD display, personal computer and triggering the relay when there is any fault. Modern power networks require faster, more accurate and reliable protective schemes. Thus microcontroller helps in

Automatic control of the system and making monitoring very easy.

3.4 LCD Display

A 16 x 2 LCD display is used to display the current of the three grids. It has 1/16 duty cycle. It works on +5v supply and also on +3v. The LCD is used to display the transformer voltage, current and temperature. Similarly, personal computer can be used to display the transformer parameters for monitoring purpose.

3.5 ULN Driver 2803

ULN drivers are used to drive the relay circuits in the system. It is connected between relay and microcontroller. The microcontroller sends the signal to relay drivers to run the relay in cases of over current.

3.6 Buzzer

Buzzer is used for the indications purpose in the system. It will produce an alarming sound when the values exceed the normal fixed values.

3.7 Relay

The relay is an electrically controllable switch widely used in industrial controls, automobiles, and appliances. It allows the isolation of two separate sections of a system with two different voltage sources. For example, a +5V system can be isolated from a 120V system by placing a relay in between them. One such relay is called an electromechanical or electromagnetic relay. The relay serves as the protective device of the entire system. The relay receives trip signal from the microcontroller. It helps in separating the transformer primary from the input ac source hence protecting the transformer.

3.8 ADC 0809

The ADC 0809 is a device with an 8-bit analog-to-digital converter. It consists of 8-channel multiplexer and microprocessor compatible Control logic. This converts analog data into digital data.

4. WORKING PRINCIPLE

The project is based on monitoring the parameters of the transformer using a microcontroller. The system consists of three current transformers on the supply side. The current flows through each of the current transformer. The current sensing block which consists of current sensors measures the current flowing through the current transformer. The main supply side transformer calculates the sum of current values of the three current transformers.

4.1 At Normal Operating Condition:

In normal conditions, the current in each of the current transformers is within limits i.e. below 0.5 amperes or up to 0.5 amperes. Thus the summation of the values of three CT's is 1.5 amp or below. In such case, the microcontroller will not send signals to the ULN drivers to activate the relays. The relay circuits will not receive any tripping signal and the current will continue to flow in the circuit to the distribution side.

4.2 At Over Current Condition:

When the current in any of the respective circuits exceeds 0.5 amperes rating automatically the value of summation of three current transformers will be more than 1.5 Amperes. In such cases the amount of current exceeding the limit will be displayed on the LCD display. The buzzer will produce a sound to warn the user and the LED of the circuit will over current will be blow off. We have to immediately reduce the load as excess load current can damage the system. If the load is not reduced in specific time then the microcontroller will send signals to ULN 2803 drivers to activate the relay. After the relays are activated, it will trip the circuit in which the fault is recognized. The relay will separate the circuit from the distribution side and thus protect the transformer.

5. RESULT

In this project there are three current transformers. The rating of each of these transformers is 0.5 amperes. Another main supply side transformer is connected which has a rating of 1.5 amperes. This transformers has the rating (1.5 amp) which is equal to summation of all the three current transformers. If the current limit exceeds 1.5 amperes due to increase in the current levels in any of the grids, the respective grid is automatically turned off by the relay.

6. CONCLUSION

In this project transformer protection by monitoring its parameters such as current is proposed. The results indicate that the microcontroller based transformer protection achieves numerous advantages over the existing systems in use: 1) fast response, 2) better isolation, 3) accurate detection of the fault. By using microcontroller we can change the type of control by changing the programming inside the controller. This system can be designed as per domestic and well as industrial requirements just by varying the limits to be controlled. Thus this project steps towards easy monitoring and thus protection of the system.

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