SIMULATION OF TRANSFORMER PROTECTION USING MICROCONTROLLER BASED RELAY & MONITORING USING GSM

[1]Shweta Mate, [2]Shital Jagtap, [3]B.S. Kunure

Department of Electrical Engineering,

ZCOER, Pune, India

***Abstract*—In Power System for Electrical Energy transfer the transformers are very important components. In order to protect transformer from various faults different protective methods are used. Some of them are over excitation protection, microprocessor based relay protection, differential protection etc. In this paper over load protection and over heat protection is established for protection of transformer. Microcontrollers based relay is used for the protection of transformer. In abnormal condition relay sends the signal to the microcontroller.**

The simulation of circuit is design in proteus software, programming is also done accordingly in MPLAB IDE software and result is analyzed successfully.

***Keywords:* Relay, over load, over heat, microcontroller, simulation.**

INTRODUCTION

In Electrical power system transformer is very important device and protection of transformer is necessary part of the protection system. Transformers are used in various applications. In power system protection of transformer is very difficult and challenging. Day by day the electrical power system demand increases due to increase in population. Because of the increasing demand the existing system gets overloaded. Due to overloading different faults are occurred on the transformer. Therefore the protection of the transformer is essential against the overloading.

Microcontroller and microprocessor are the latest trends to protect the transformer from various faults.

Literature review:

The data acquisition board and digital processing board are in built in relay and which are based on TMS320E15 processor. The relay design is based on the Fourier algorithm. The conclusion is that the relay never misoperated and identified all the faults[1]

The system protect transformer from inrush current, internal faults, over current protection, over voltage protection and under voltage protection. The system uses M68HC11 Motorola microcontroller [2]

The differential protection system gives protection against over excitation, current transformer saturation phenomenon due to relay misoperation. Differential relay used to overcome these faults [3]

Therefore proposed solution is use of microcontroller based relay to protect transformer against over load and over heat. The microcontroller based relay has different features like, greater reliability, high accuracy, compact size, low cost, high switching capacity, minimized failure, low power to energies.

Therefore proposed solution is use of microcontroller based relay to protect transformer against over load and over heat. The microcontroller based relay has different features like, greater reliability, high accuracy, compact size, low cost, high switching capacity, minimized failure, low power to energies.

1.1 Proposed Method:

Now days fast processing of fault detection is required and it also require reliable and accurate protection against detected fault. Microcontroller gives fast processing speed. Microcontroller has different features like, large memory capacity, in built ADC, self-programmable.

The proposed method is used tomonitoring and protecting the transformer from over load and over heat.

Due to all above reasons over microprocessor relay, microcontrollers based relay is need of hour. Microcontroller relay is a recent development for all types of faults. So microcontroller based relay is used for protection of transformer.

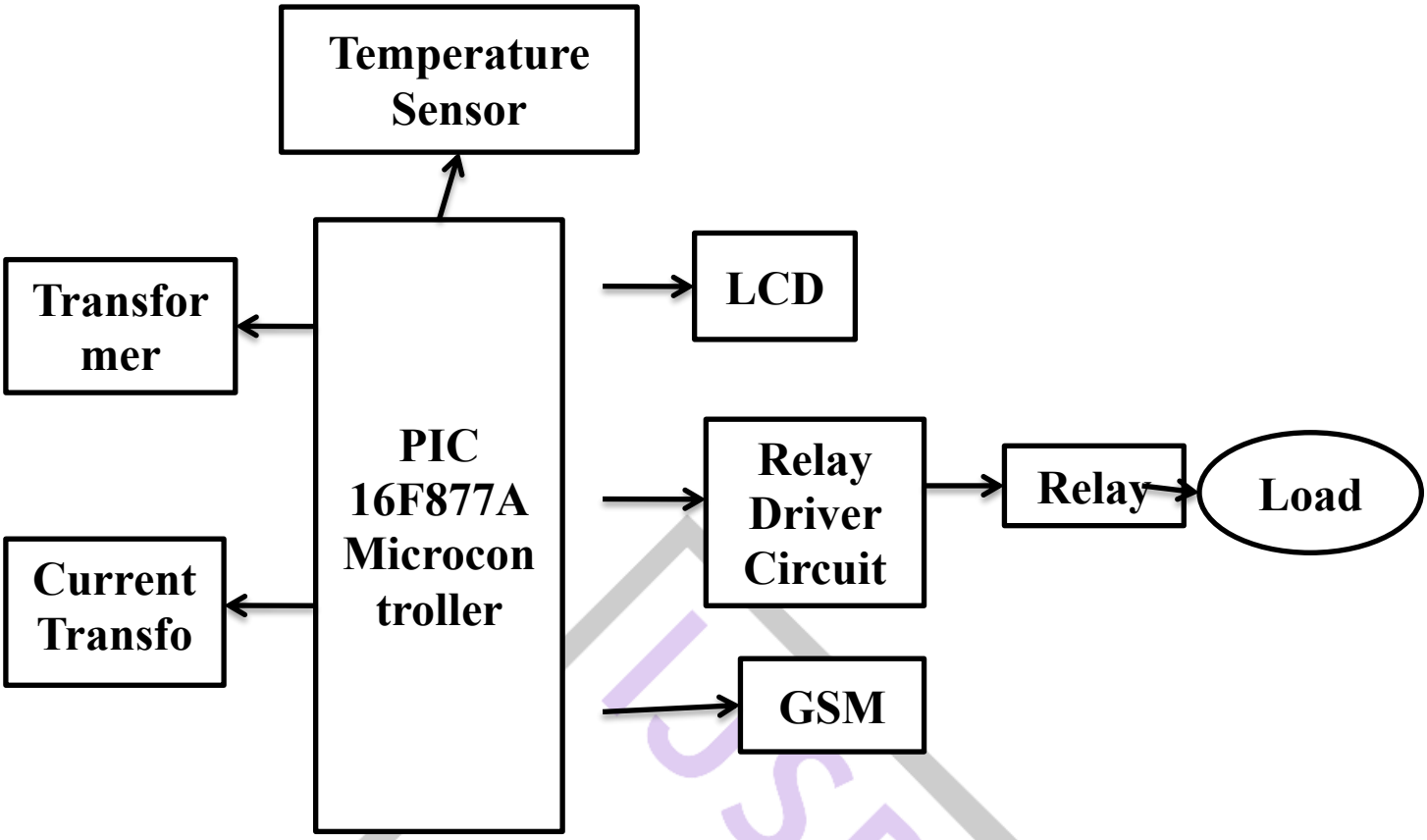

Fig. Block Diagram

WORKING PRINCIPLES OF BLOCKS

1) Transformer:

The transformer is device which to be protected. The transformer having primary voltage greater than secondary voltage is called the step down transformer. The step down transformer is convert primary side high voltage to secondary side low voltage. The cost of transformer is very high so protection is needed.

2) Load:

Depending upon applications the load is used.
The industrial and residential type load is used.

1) Current Transformer :

Current transformer is the electrical device which produces an alternating current in the secondary which is proportional to AC in the primary. Here, step down CT is used for the protection purpose. The rating of the CT is 20 A to 20mA.

2) PIC 16F877A Microcontroller :

PIC 16F877A is the brain of this protection circuit. The main advantage of this is, it has inbuilt ADC, which converts analog value to digital value (sampled value). This sampled values compared with preset values and decision is taken according to programming, hence microcontroller is decision making device.

It is simple and compact circuit, and gives fast response as compared to processor. Power consumption is less for PIC 16F877A microcontroller. It can be used anywhere, such as commercial or industrial because it has wide range of temperature. It also provides programmable code protection.

3) Relay Driver Circuit :

In this circuit, NPN transistor is used for controlling operation of relay. Microcontroller sends trip signal to this circuit.

4) Relay :

Relay is a switch which is used to provide isolation.When a fault is occurs in a particular zone of a system the relay is excepted to operate and initiate isolation of the faulty element.

It is an electrically operated switch. In past several years solid state relays are used for protection purpose, but due to advancement in technology microcontroller based relays are used for protecting the devices.
Electromechanical relays are electrically operated switch used to isolate circuit and detect fault in the transformer.
It gives high reliability, relative simplicity, and safe disconnection from the main supply. It has longer life.

5) Temperature Sensor :

For this protection circuit we used LM35 temperature sensor. It is precision IC temperature sensor. In this output of sensor is directly proportional to the temperature. This is more accurate than thermistor. Also it possesses low self-heating.

6) LCD Display :

LCD is used to display value of power and temperature. With respect to change in load, the power and temperature is changes accordingly.

It is used to display condition of overload and overheat as per changes in load and it will be displayed on LCD display. So, we can see normal and abnormal conditions on display. As per this we can take necessary action

.

7) Rectifier :
Rectifier is device to convert AC voltage into DC voltage. We used bridge rectifier to convert AC voltage into DC voltage.

8) Filter :

Output of rectifier is not a pure dc it is a pulsating dc. To convert pulsating dc into pure dc the filter circuit is used.

9) GSM :

Global system for mobile communication is used for digital cellular communication. Its frequency range is 900 MHz to 1990 MHz. PIC microcontroller sends actual load value to authority via SMS by using GSM.

COMPONENTS USED

a) Step Down Transformer: (230/12V)

b) Power Supply Circuit-
1. Bridge Rectifier
2. Capacitor (1000µF, 25V)
3. Regulator (7812 & 7912), +12 & -12
4. Capacitor (470µF, 16V)

c) Current Sensing Circuit-
1. Variable Resistor (10K)
2. Capacitor (100µF,63V)
3. Diode (1N4148), 25V
4. Resistor (10K)
5. LM324 (3V-32V, 100nA, 150ºC Junction Temperature)

d) Current Transformer (230V AC, 2A to 20mA)

e) Relay (7A, 12V)
1. Diode (1N4007), 1A,50-1000V
2. Transistor (BC547), (Vce=45V, Vcb=50V, Vbe=0.7V, Ic= 100mA)
3. Resistor (330Ω)

f) GSM Module (SIM900A)

g) Microcontroller Kit
1. DC Jack
2. Bridge Rectifier
3. Regulator (7805)
4. Capacitor (1000µF, 35V)
5. Resistor (330Ω, 10K)
6. Crystal Oscillator (20MHz)
7. Capacitor (22µF, 5V)
8. Reset Switch
9. Controller 16F877A (5V, 40 Pin IC)
10. LCD (16x2)

WORKING OF SIMULATION CIRCUIT

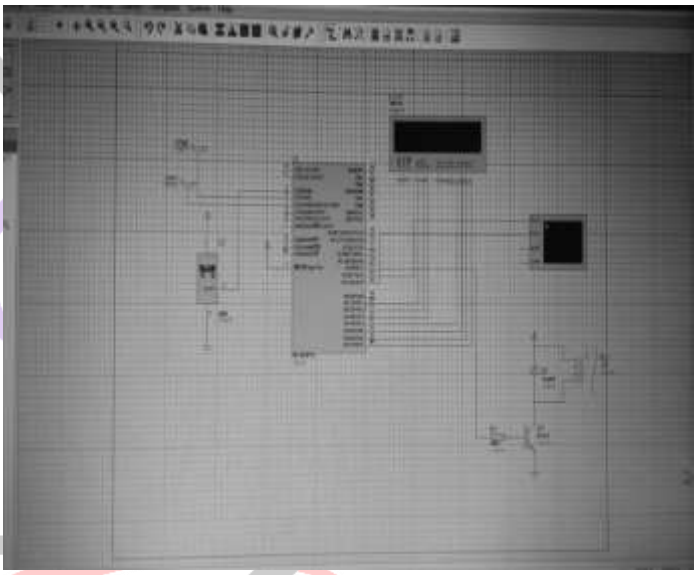

Fig. Normal working of simulation circuit

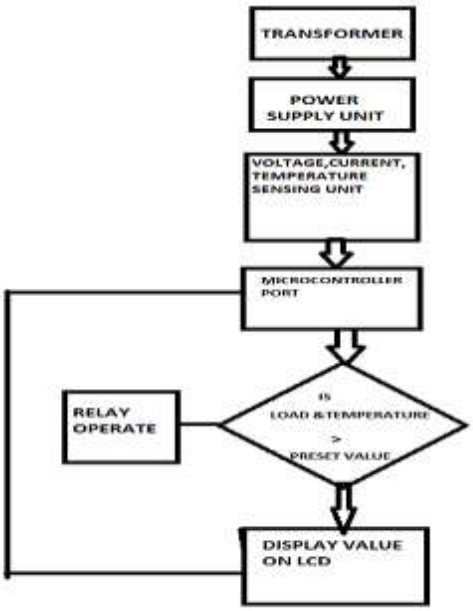

Fig.(a) Flowchart

1.2 Working of Simulation Circuit:

- The circuit is used to monitoring the load and temperature. By using step down transformer the supply voltage is step down 230v/12v.
- The step down voltage is then given to the power supply circuit.to get pure DC voltage the power supply circuit consist of bridge rectifier, filter, regulator IC and harmonic distortion capacitors.
- The LCD will continuously monitor the power and temperature and display its values by specific delay.
- If the value of power and temperature is not within the range that is not within the preset value the microcontroller give the trip signal to the relay.
- Then relay isolate the faulty part from the system. The relay will trip within the microsecond
- Bridge rectifier which rectifies the step down voltage.
- Capacitor is used as filter, harmonic distortion, charging/ discharging purpose and diodes are used for reverse protection.
- Here, Reference value of temperature and load is set.
- Preset value of load is 90 Watt and preset value of temperature is 40ºC.
- If load exceeds greater than 90 Watt then microcontroller send trip signal to transistor and relay will trip within microseconds.
- As relay will trip, transformer will be disconnected from supply. At the same time using GSM technology, GSM module will send "Transformer Overloading" this SMS will send to the prescribed mobile numbers.
- Similarly, if temperature exceeds limit greater than 40ºC then microcontroller send trip signal to transistor and the relay will trip in few microseconds.
- As relay will trip, transformer will be disconnected from the supply. At the same time, GSM module send the "Transformer Overheating" this SMS will send to prescribed mobile numbers.

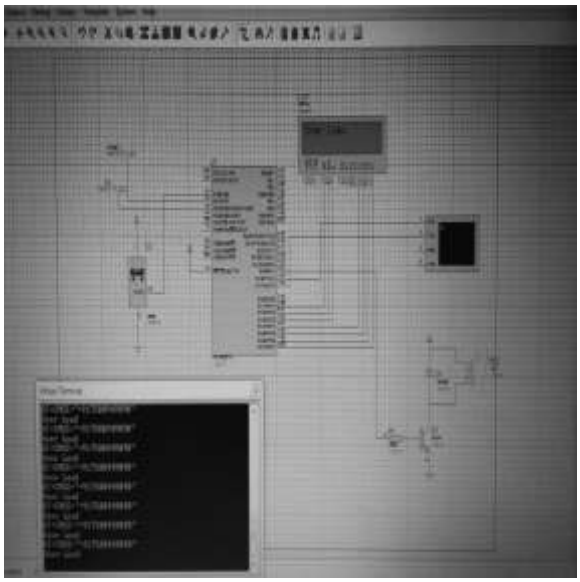

Fig.Circuit diagram during Overload

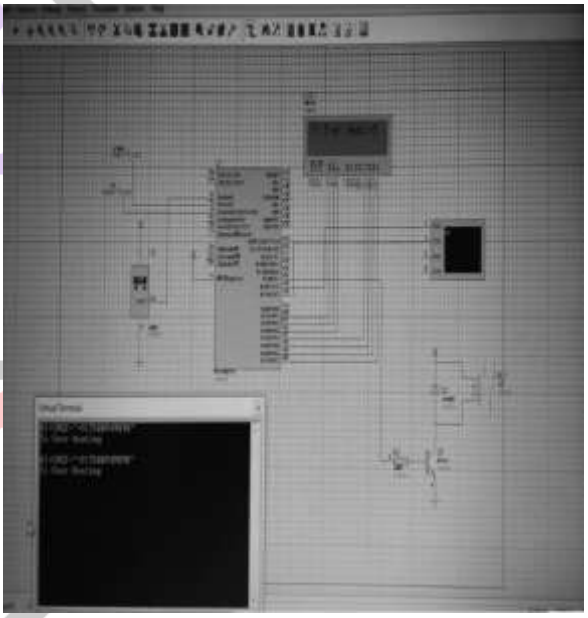

Fig. Circuit diagram during Overheating

CONCLUSION

This method gives faster and reliable protection than previously used methods. Because of microcontroller is used this method is very fast and accurate method. The maintenance required for this system is very less. Cost require is also less.

This system provides transformer protection using microcontroller based relay. For transformer voltage and current sensing, current sensing circuit were designed and result have been verified with proteus simulation. Hardware with microcontroller is implement to verify proposed technique compared with proteus computer simulation.

REFERENCES

1. Hermanto, I.; Murty, Y.V.V.S.; Rahman, M.A., "A stand-along digital protective relay for power transformers," in Power Delivery, IEEE Transactions on, vol.6, no.1, pp.85-95, Jan1991 doi: 10.1109/61.103725
2. Journal of Applied Sciences 7(12): 1602-1607, 2007. ISSN 1812 -5654. 2007 Asian Network for Scientific Information
3 Armando Guzman, Member, IEEE, Current based solution for transformer differential protection
4 Badri Ram and D N Vishwakarma, Power System Protection and Switchgear, second edition.
5 Roger C Dugan, Electrical power systems quality, second edition
6 Muhammad Ali Mazidi, PIC Microcontroller and Embedded System
7 V K Mehta, Basics of electrical engineering.