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Simulation of Power Transformer Protection Using Microcontroller Relay

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Abstract :Power transformers are key components for electrical energy transfer in a Power system. In order to protect the transformers from these faults different protective methods are adopted. Some of them are differential protection, over excitation Protection, etc. In this Paper Over Voltage protection is established for the protection of the transformer. Microcontroller is used for the Power Transformer Protection as a relay. It will sense the fault
Due to over voltage of about +5% and send trip signal to the relay driver circuit and the power transformer will automatically get isolated from the system. The Simulation circuit is designed in Proteus Software and analyzed successfully. The Programming is also done accordingly.

Keywords – Microcontroller, over voltage, relay, simulation

I. INTRODUCTION

The power transformer is one of the most significant equipment in the electric power system, and transformer protection is an essential part of the general system protection approach. Transformers are used in a wide variety of applications, from small distribution transformers serving one or more users to very large units that are an integral part of the bulk power system.

. With the increasing population and their unavoidable demands, leads to the high increase demands on electrical power. With this increase in demand of power, the existing systems may become overloaded. The overloading at the consumer end appears at the transformer terminals which can affect its efficiency and protection systems. One of the reported damage or tripping of the distribution transformer is due to thermal overload. To escape the damaging of transformer due to overloading from consumer end, it involves the control against over current tripping of distribution transformer.

Where the technology of the day has given the opportunity to use the latest trends, and microprocessor, microcontrollers are one of the day requirements to apply in the remote protection of the transformer.

The Protective relays require reasonably accurate reproduction of the abnormal and normal conditions in the power system for correct sensing and operation. This information input from the power systems are usually through Current Transformer (CT) and Voltage Transformer (VT).

Literature survey reveals work of [1] for load up to 2 KVA and to protect load such as refrigerator, TV, VCR/DVD etc from over/under voltage by microcontroller. [2] has discussed protection of power transformer for various faults using microcontroller based relay for software and hardware development.[3] has done real time monitoring and control of transformer by using ARM7 processor, RF trans receiver for wireless communication and sensors for state of transformer making it as embedded system. Similarly [8] has detailed alternative to fuse protection. Also it has discussed power transformer protection against fault from power transformer due to overload, high temperature or high input voltage, monitor and control information about operating parameters and transmitted to a PC through VB GUI interface.[9] has described microcontroller based transformer monitoring and controlling by zigbee. It monitors V, I, f, and temperature and isolate in emergencies using zigbee transreceiver and sent to PC.

Therefore a proposed solution is chosen to develop a microcontroller based transformer overvoltage protection prototype because the microcontroller based relays provides greater flexibility, more adjustable characteristics, increased range of setting, high accuracy, reduced size, and lower costs, along with many ancillary functions, such as control logic, event recording, fault location data, remote setting, self-monitoring and checking, etc.

II PROBLEM FORMULATION

Modern power system applications require fast processing of fault current envelop and also it requires accurate and reliable algorithms for computation of fault. Micro-processor based relay does not have fast processing speeds in comparison to microcontroller based relay.

Also the memory of microcontroller has large capacity in comparison to microprocessor. Microcontroller has inbuilt peripherals in comparison to microprocessor. Microprocessor has one processor while micro controller has two processors.

Due to all above reasons, for smart grid applications, micro controller based relay is the need of the hour. Thus micro controller relay is recent development for all faults.

PROPOSED METHOD

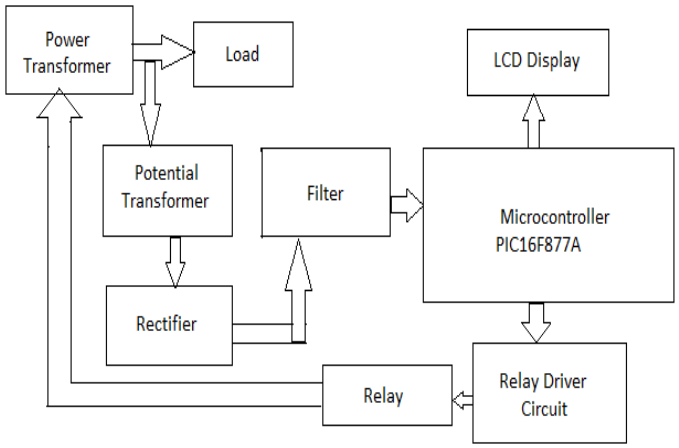

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Figure 1: Block diagram of the simulation circuit using microcontroller relay.

In proposed method, monitoring and protecting the power transformer from overvoltage is performed automatically by using PIC microcontroller.

2.1Working Principle of the blocks:

2.1.1**.** Power Transformer:

The Power Transformer is the device for which we design the protection circuit. Usually the transformer having MVA rating above 5MVA is known as Power Transformer. Their cost is very high, so adequate protection must be required to protect it from faults.

2.1.2. Load:

Load may be industrial type or residential type or both the type connected to the power transformer, which varies continuously with time.

2.1.3. Potential Transformer:

Potential transformer is a simple transformer which steps down the power transformer voltage to the voltage required for the working of the control circuit. In the circuit this voltage is 12V, so use of 230V/12V potential transformer.

2.1.4. Rectifier:

This is a device which converts ac voltage to the dc voltage. So, we use 4 1N4007 diodes which convert a.c voltage to the d.c voltage.

2.1.5. Filter:

The voltage we obtain from rectifier is pulsating d.c.so, we use capacitor as a filter which converts pulsating d.c voltage to the pure d.c voltage.

2.1.6. PIC 16F877A Microcontroller:

The PIC 16F877A microcontroller is the brain of our control circuit. It has in-built ADC (Analog to digital converter) which converts d.c voltage into digital value in the sample form. This sampled value then compared with the pre set value and the decision has been made according to the programming done in the microcontroller. So, microcontroller is the decision making device of our circuit. We use the PIC 16F877A as the microcontroller because it has in-built ADC, which makes the circuit simpler and compact. In addition the operating speed is faster than any microcontroller available in the market and the power consumption is less. We can use it anywhere in commercial and industrial places because it has wide operating temperature range.

2.1.7. Relay Driver Circuit:

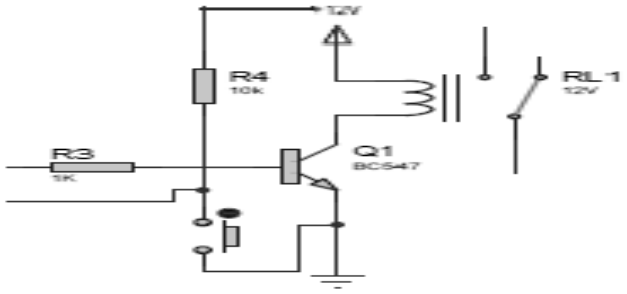

Figure 2:Relay Driver Circuit

This is an NPN transistor which controls the operation of the relay. When the microcontroller sends the trip signal to the relay driver circuit the transistor operates in the switching region and disconnect the power transformer from the main supply automatically, otherwise normal operation is carried out.

2.1.8. Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

2.1.9. LCD Display:

The LCD Display is used to display the supply voltage and it will change as the load will be changed and displays on to the LCD display. So, the operator in the substation can see the readings and take necessary actions when abnormal condition occurs.

2.2. Designing of the components used:

2.2.1. Potential transformer with 230V/12V:
Setting the transformer ratio
L1/L2=(N1/N2)^2=(V1/V2)^2
L1=1H
So,L2=0.00272H
Transformer ratio 162.63/8.48 rms V
2.2.2. Four diode bridge rectifier with four 1N4007 diode
Diode Bridge Rectifier
O/P Vdc=Vac-(2*0.7)
Vdc=8.48-1.4=7.06V
2.2.3. Filter design
Filter : Rload*C>>(1/f) : C>>0.83 mF
C=12MHz Crystal
So, We select 1mf capacitor as a filter.
2.2.4. Relay and driver circuit design
+12v relay, 240 ohm resistance
Load current IL = 12/240=50 mamp
Hfe= il/Input, let us assume Hfe=100(for BC547)
Iinput=0.05/100=0.50 mamp (for saturation)
Rb=Vo-Vbe/Iinput ,now let Rb =1kohm
Iinput=(5-0.7)/1000=4.3 mamp>0.5mamp
So, Rb=1 K

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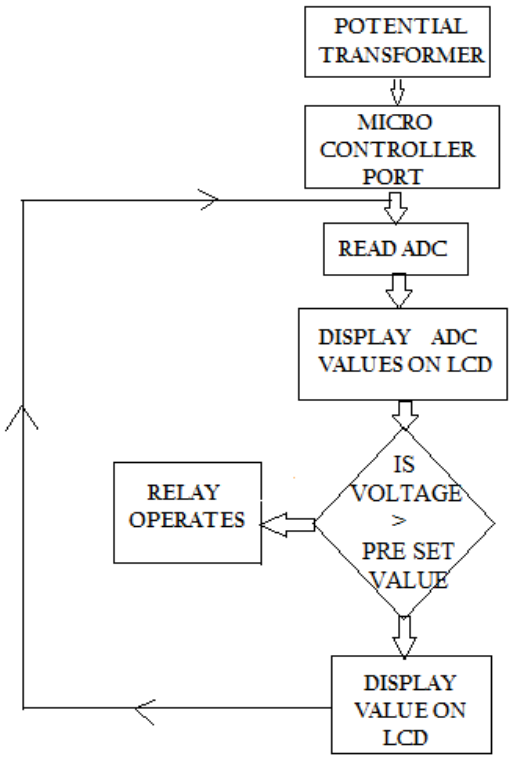
2.3. Working of the Simulation Circuit:

This circuit is designed to monitor the supply voltage. The supply voltage that has to monitor is step down by the potential transformer. We are using the 230v/12v potential transformer. Figure 3:Flowchart of the circuit



- The step down voltage is rectified by the bridge rectifier.
- To have the smooth output voltage capacitor filter is used.
- In actual condition over voltage will occur itself but in software have to create the fault so, potentiometer is used to produce over voltage. Here it is decided that the fault level of **9V.(Usually fault level is to be considered as 5% of the normal system voltage.)**
- Potentiometer can also be used to divide the voltage under microcontroller range.
- The output from the potential divider is given to one of the ports of the microcontroller.
- Here LCD will continuously monitor the system voltage.
- Here normal voltage is 9V as shown in figure 4. Normal voltage can vary depending on the different types of system.
- This normal voltage is continuously compared by PIC16F877A microcontroller with the fault level of 9V.
- If the normal voltage is below the fault level then relay will not operate and lcd will continue to monitor the voltage
- Now let arrange the potentiometer such that voltage appearing at the port of the PIC is greater than 9V(fault level).
- Now as voltage just exceeds the 9V, microcontroller will send trip signal to the transistor and '**relay will trip within the microseconds' whose result is shown in fig 5.**
- As relay will trip power transformer will be disconnected from the supply as shown in the figure and voltage across it will become zero .
- As soon as the fault will be cleared, we can reset the relay by reset button and system can start working normally.

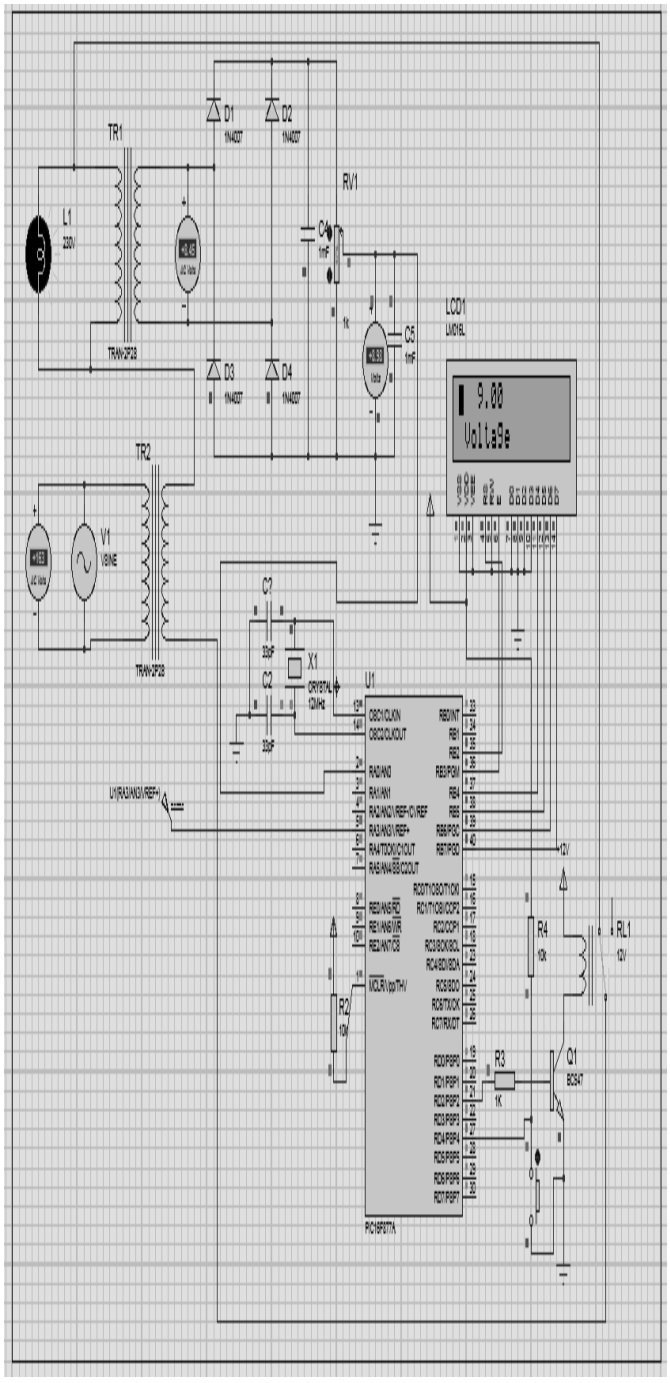


Figure 4: The Circuit under normal condition.

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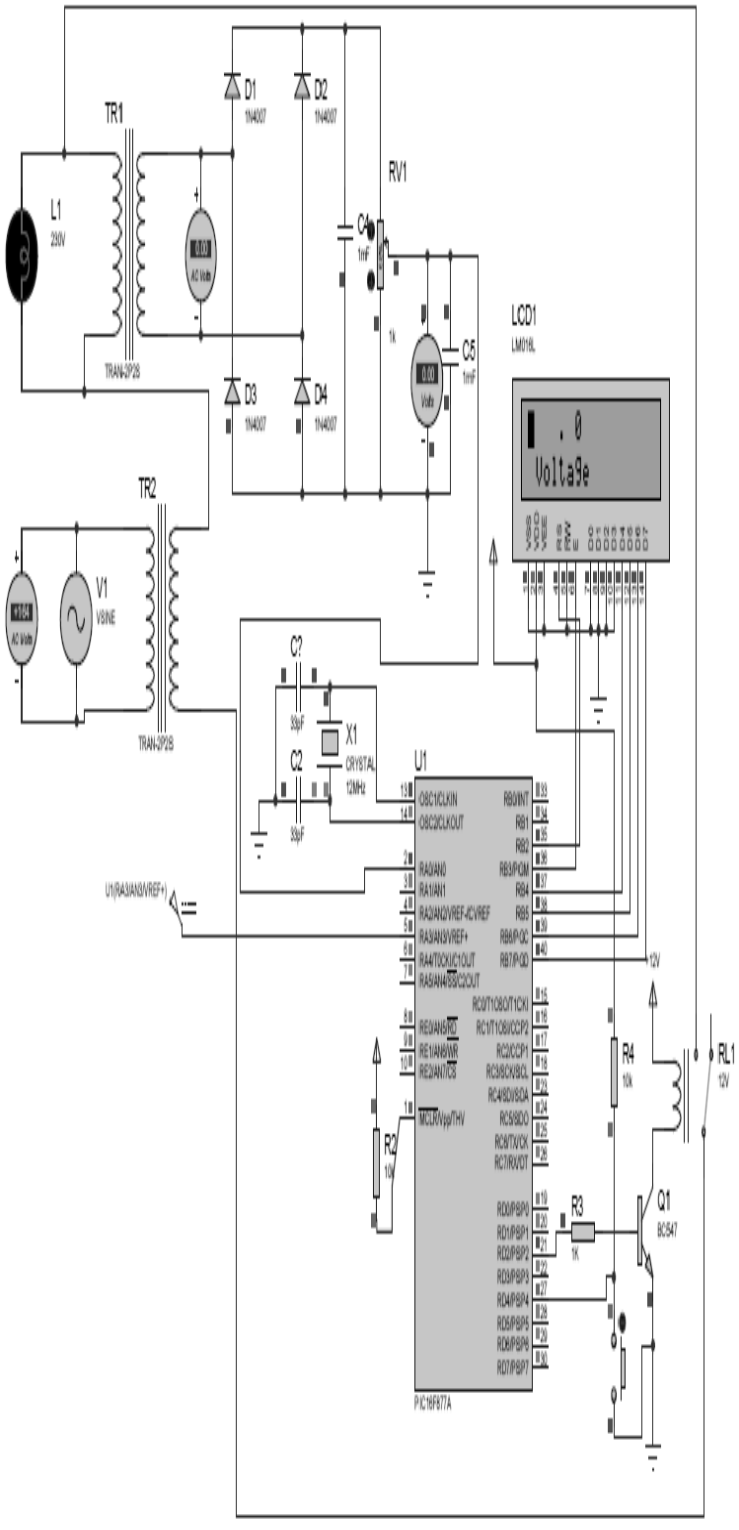

Figure 5: The circuit under faulty (Trip) condition

III. OBSERVATIONS:

- As voltage increases above preset value relay operates within microseconds.
- So, Power transformer disconnects automatically from the load.
- Voltage decreases zero immediately.
- Hence, the Power Transformer isolate from the system and avoid it from burning due to Overvoltage.

IV. CONCLUSION

This system provides a better and safer protection than the other methods which are currently in use. The advantages of this system over the current methods in use are fast response, better isolation and accurate detection of the fault. This system overcomes the other drawbacks in the existing systems such as maintenance and response time. The main advantage of the proposed method is that it is very economical and very compact in size than the other methods currently in use.

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REFERENCES:

i. Ponnle A. A, Omojoyegbe M. O.,"Development of a Low Cost Microcontroller Based Under and Over Voltage Protection Device", International Journal of Scientific Engineering and Technology (ISSN : 2277-1581) Volume No.3 Issue No.9, pp : 1225-1229,1 SEPTEMBER ,2014.

ii. S.M Bashi, N. Mariun and A.rafa (2007). 'Power Transformer protection using microcontroller based relay', Journal of applied science, 7(12), pp.1602-1607.

iii. S.Dharanya,M.Priyanka,R.Rubini and A.Umamakeswari;"Real Time Monitoring and Controlling of Transformers", Journal Of Artificial Intelligence 6(1):33-42 2013.

iv. Technical Research Paper ,"Microcontroller based Fault Detector" ,International Journal of Advancements in Research & Technology, Volume 1, Issue 5, October-2012 1 ISSN 2278-7763 .

v. Badri Ram and D N Vishwakarma," Power System Protection and switchgear,"2nd Edition, Tata Mcgraw Hill education Pvt Limited.

vi. Ravinder P Singh," Digital Power System protection", Prentice Hall of India Private Limited.

vii. Pooja Dubey, Sushma Nagpure and Chhaya Janghela," Automation Of Distribution Transformer Using Microcontroller", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181,Vol. 2 Issue 10, October – 2013.

viii. Three Phase Over Current +Earth Fault Relay With Highest With Communication Type MC61C ,L & T Switchgear broucher.

ix. A.Z.loko, A I bugaje, A A bature," Automatic method of protecting transformer using PIC microcontroller as an alternative to the fuse protection technique, IJTRA, e-ISSN:2320-8163, vol 3,issue 2, mar-Apr 15, pp:23-27.

x. Y G Paithankar, S R Bhide,"fundamentals of power System Protection" Prentice Hall of India Learning private Limited.