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Overcurrent Protection of Transformer by incorporating IDMT function with the help of Arduino Uno Microcontroller

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***Abstract* – Power transformer is an important and vital part of the electrical power system, there protection and continuous monitoring is very crucial for an uninterrupted power supply. There are various types of relays available for protection of transformer, one of the relay commonly known is IDMT relay. IDMT relays usually uses eddy current effect for attaining inverse definite minimum time (IDMT) relation but by using a microcontroller instead, will give relay more appropriate operation and better time response. Here in this paper IDMT scheme is applied to the relay through microcontroller. A current sensor is also developed which will give DC output voltage in proportion to increasing load current and the same voltage levels are being used for programming.**

Key Words---Arduino Uno; Overcurrent; Microcontroller; IDMT; Proteus Software; Relay.

I. INTRODUCTION

The function of power system protection relays is to detect faults or unusual operating conditions and to instigate corrective action. Relays must be able to evaluate a wide variety of parameters to establish that corrective action. Apparently, a relay cannot prevent the fault but its primary purpose is to detect the fault and take the necessary action to minimize the damage to the equipment or to the system. The most common parameters which reflect the presence of a fault are the voltages and currents at the terminals of the protected apparatus [1]. The Protective relays need 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 and Potential Transformer.

Also, for the past several years circuit breakers, fuse and electromechanical relays were used for the security of power systems. The conventional protective fuses and electrometrical relays present several draw backs.

On the other hand, some researches were conducted on relay which can be interfaced to microprocessors in order to eliminate the drawbacks of the traditional protective techniques [2] which led to various improvements in transformer protection in terms of lower installation and maintenance costs, better reliability, improved protection and control and faster restoration of outages.

Some scholars have also developed differential protection scheme for transformer security by using two current transformers which are connected at each side of transformer i.e. primary and secondary side. AC voltage attained by these sensors are rectified to pure DC and the same is fed in to the microcontroller for further process.[3]

By incorporating microcontroller in to protective relays there are more flexible and remote operations are possible, like by shutting down the equipment under fault condition with the help of radio communication [4].

By reviewing other relevant researches the IDMT scheme is proposed and developed with the help of microcontroller in this paper.

II. DETAILS OF PROPOSED SCHEME

A. Construction of current sensor circuit

Developing a current sensor is the primary consult as deriving a constant (DC) voltage through variable AC current is quite typical. Microcontroller is crucially restricted to low voltage and low current inputs as high value of current and voltage will damage the microcontroller. More is the value of stable and proportionate voltage to the changing current is attained better will be the functioning of the system. Circuit diagram of the proposed current sensor is shown in Fig-1 In this a CT(current transformer) is connected in series with load. As the load is varied current flowing in CT also changes and accordingly DC voltage is obtained through bridge rectifier and filter capacitors. A voltage divider circuit is used to limit the output value to the safe limit of microcontroller. The value of R1= 10K ohm, R2= 20K ohm, C1= 220 micro farads, C2= 0.1 micro farads and a 100k variable resistance(VR1) is used. Values attained at current

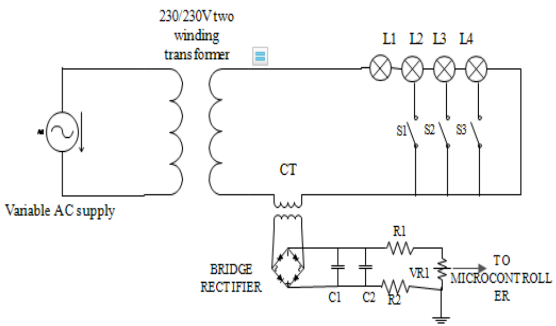

Fig-1 Current sensor circuit connected with variable AC source and variable load.

sensor terminals with variable load and variable voltage are shown in Table 2

Table 2

S.no	Current sensors values at different loads			
	AC Input Voltage(V)	L2 ON (DC V)	L2&L3 ON (DC V)	L2,L3&L4 ON (DC V)
1.	159	0.58	1.06	1.58
2.	168	0.6	1.1	1.59
3.	177	0.61	1.12	1.60
4.	184	0.62	1.17	1.61
5.	193	0.63	1.20	1.63
6.	204	0.64	1.24	1.66
7.	211	0.65	1.27	1.69
8.	220	0.67	1.31	1.72
\9.	230	0.68	1.35	1.75

Table 2:- Current sensors values at different loads

The values attained by current sensor are accurately proportionate to the varying load and are also suitable to feed the same voltage in to the micro controller.

B. Flow chart and functioning of the system.

Programming for the proposed system is being done according to the flow chart shown in Fig-2.

In the flow chart three over current ranges are used I_{ol1}, I_{ol2} and I_{ol3} .Here these three over currents correspond to different loading conditions. $I_{ol1}<I_{ol2}<I_{ol3}$ .If we consider normal voltage range to be from 184 volts to 204 volts then from table 1 I_{ol1} will be considered if output of current sensor is in range from 0.62 to 0.64 volts. And in the same way ranges for other over current are taken. Now to achieve IDMT relation between value of over current and time of relay tripping, value of Time T_1, T_2 & T_3 will be set in such a way that $T_3< T_2< T_1$. In this way IDMT relation is obtained.

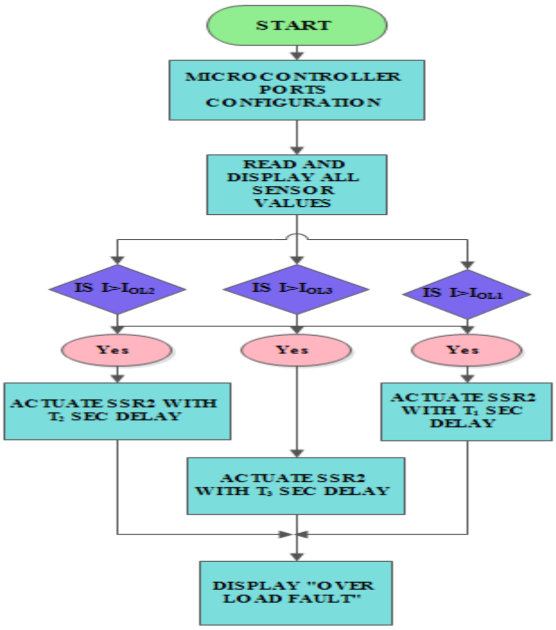

Fig-2 Flow chart of the algorithm used for programming.

C. Construction of complete circuit on Proteus software

In Fig-3 complete circuit diagram of the system is shown. Proteus software is used to check the proper working of the electronic circuits and also it is helpful in rectifying hidden errors while choosing values of different components.

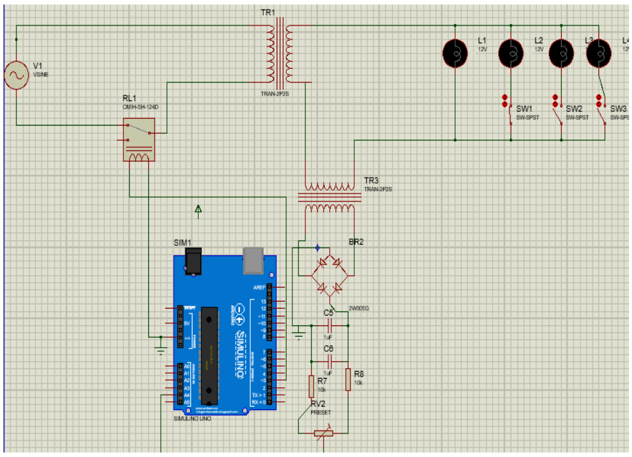

Fig-3 circuit diagram of system on Proteus software

III. CONCLUSIONS

Use of micro controller in protective relays have many advantages like more protection for less cost,wiring simplification, greater flexibility, less maintenance requirements, reduction in panel space—less devices required, event recording capability, ability to calculate and display distance to fault, data acquisition for metering, built-in logic for control and automation, self-checking capability, communication capability—ability to design enhanced protection schemes, capability for remote interrogation and setting application, ability to change settings automatically based on system conditions.

Some disadvantages of using microprocessor-based relays includes:

1. Single failure may disable many protective functions.
3. Excessive input data required for settings and logic.
5. Difficulty in matching input software with relays, especially when relays have been field modified.

So looking at merits and demerits of using microcontroller based protection schemes is far better than using simple protective schemes.

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