Automatic load Sharing of Transformer

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ABSTRACT

This project Report describes Automatic Load Sharing of Transformers to protect the transformers under overload condition and makes sure the supply is uninterrupted. When load on transformer one exceeds 0.7 mA then the secondary transformer that is slave transformer will automatically turn ON. Our main purpose of this project is to give us uninterrupted power supply. Our power distribution system works on Transformer; it is main component in the system if it gets overloaded then the supply will stop. A lot of peoples have faced power cut due to the transformer failure and it takes too much time to restore the supply for such times this project can give us the continuous power flow until the main transformer backs in action. Nowadays it has become a main concern to overcome from this problem this project is going to be very helpful such problems were a source of motivation for this project. If we connect another one transformer in parallel with main transformer, then if main transformer gets overloaded then the slave transformer will come into work and the supply will continue. Three phase transforms having a pair of additional coupled windings on the secondary side of each phase, with these coupled windings properly connected in series to develop a voltage in phase with a particular secondary voltage but driven from alternate phase primaries. The primary and secondary windings are connected in a Y or A configuration. One coupled winding from each of the two phases, other than the desired secondary phase which is to be balanced, are joined in negative series so that when summed, they are aligned with the secondary phase are being corrected. The series coupled windings are connected in parallel with the third secondary.

Keyword : - *Transformer, Arduino Uno, Current transformer, Relay, LCD*

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1. INTRODUCTION

The transformer is a static device, which converts power from one level to another level. The aim of the project is to protect the transformer under overload condition by load sharing. Due to overload on transformer, the efficiency drops, and windings get overheated and may get burnt. Thus, by sharing load on transformer, the transformer is protected. This will be done by connecting another transformer in parallel through a micro-controller. The micro controller compares the load on the first transformer with a reference value. When the load exceeds the reference value, the second transformer will share the extra load. Therefore, the two transformers work efficiently, and damage is prevented. In this project three modules are used to control the load currents. The first module is a sensing unit, which is used to sense the current of the load and the second module is a control unit. The last module is micro controller unit and it will read the analogue signal and perform some calculation and finally gives control signal to a relay. The advantages of the project are transformer protection, uninterrupted power supply, and short circuit protection.

1.1 Literature Survey

In 1881 two electricians built the world's first power system at Goodling in England. It was powered by a power station consisting of two waterwheels that produced an alternating current that in tum supplied seven Siemens arc lamps at 250 volts and 34 incandescent lamps at 40 volts. However, supply to the lamps was intermittent and in 1882 Thomas Edison and his company, The Edison Electric Light Company, developed the first steam powered electric power station on Pearl Street in New York City. The Pearl Street Station initially powered around 3,000 lamps for 59 customers. [2] The power station used direct current and operated at a single voltage. Direct current power could not be easily transformed to the higher voltages necessary to minimize power loss during long-distance transmission, so the maximum economic distance between the generators and load was limited to around half-a-mile (800 m). That same year in London Lucien Gaulard and John Dixon Gibbs demonstrated the first transformer suitable for use in a real power system. The practical value of Gaulard and Gibbs' transformer was demonstrated in 1884 at Turin where the transformer was used to light up forty kilometers (25 miles) of railway from a single alternating current generator. Despite the success of the system, the pair made some fundamental mistakes. Perhaps the most serious was connecting the primaries of the transformers in series so that active lamps would affect the brightness of other lamps further down the line. Following the demonstration George Westinghouse, an American entrepreneur, imported a number of the transformers along with a Siemens generator and set his engineers to experimenting with them in the hopes of Improving them for use in a commercial power system. In July 1888, Westinghouse also licensed Nikola Tesla's US patents for a polyphase AC induction motor and transformer designs and hired Tesla for one year to be a consultant at the Westinghouse Electric & Manufacturing Company's Pittsburgh labs. One of Westinghouse's engineers, William Stanley, recognized the problem with connecting transformers in series as opposed to parallel and also realized that making the iron core of a transformer a fully enclosed loop would improve the voltage regulation of the secondary winding. Using this knowledge, he built a much-improved alternating current power system at Great Barrington,

Massachusetts in 1886. By 1890 the electric power industry was flourishing, and power companies had built thousands of power systems (both direct and alternating current) in the United States and Europe. These networks were effectively dedicated to providing electric lighting. During this time a fierce rivalry known as the "War of Currents" emerged between Thomas Edison and George Westinghouse over which form of transmission (direct or alternating current) was superior. In 1891 Westinghouse installed the first major power system that was designed to drive a 100 horsepower (75 kW) synchronous electric motor, not just provide electric lighting, at Telluride, Colorado .On the other side of the Atlantic, Mikhail Dolivo Dobrovolsky built a 20 kV 176 km three-phase transmission line from Lauffen am Neckar to Frankfurt am Main for the Electrical Engineering Exhibition in Frankfurt. In 1895, after a protracted decision-making process, the Adams No. 1 generating station at Niagara Falls began transferring three-phase alternating current power to Buffalo at 11 kV. Following completion of the Niagara Falls project, new power systems increasingly chose alternating current as opposed to direct current for electrical transmission. Developments in power systems continued beyond the nineteenth century. In 1936 the first experimental HVDC (high voltage direct current) line using mercury arc valves was built between Schenectady and Mechanicville, New York. I-IVDC had previously been achieved by Series-connected direct current generators and motors (the Theory system) although this suffered from serious reliability issues. In 1957 Siemens demonstrated the first solid-state rectifier, but it was not until the early 1970s that solid-state devices became the standard in I-IVDC. In recent times, many important developments have come from extending innovations in the ICT field to the power engineering field. For example, the development of computers meant load flow studies could be run more efficiently allowing for much better planning of power systems. Advances in information technology and telecommunication also allowed for remote control of a power system's switchgear and generators.

1.2 Load Balancing

Load balancing, load matching, or daily peak demand reserve refers to the use of various techniques by electrical power stations to store excess electrical power during low demand periods for release as demand rises. The goal would be for the power supply system to see a load factor of 1. Grid energy storage stores electricity within the transmission grid beyond the customer. Alternatively, the storage can be distributed and involve the customer, for example in storage heaters running demand-response tariffs such as the United Kingdom's Economy 7, or in a vehicle-to-grid system to use storage from electric vehicles during peak times and then replenish it during off peak times. These require incentives for consumers to participate, usually by offering cheaper rates for off peak electricity. In a very basic demand balancing system, the power company sends a signal down the line or by a dedicated phone chip to turn on a special circuit in the home. Typically, a storage device for space heating or a water heater will be connected to this circuit. The electricity is turned on after the evening peak demand and turned off in the morning before the morning peak demand starts. The cost for such power is less than the "on-demand" power which makes it worthwhile for the user to subscribe to it. A nuanced system is possible with benefits for the power company and the electricity use. Once home devices contain the appropriate electronics, it will no longer be necessary to have devices connected to a special circuit. The power company can send a signal saying that power is now available at a better rate and this signal will tum on any device (dish washer for instance) that has the dial set for "when available" power (priority2).

2. BLOCK DIAGRAM

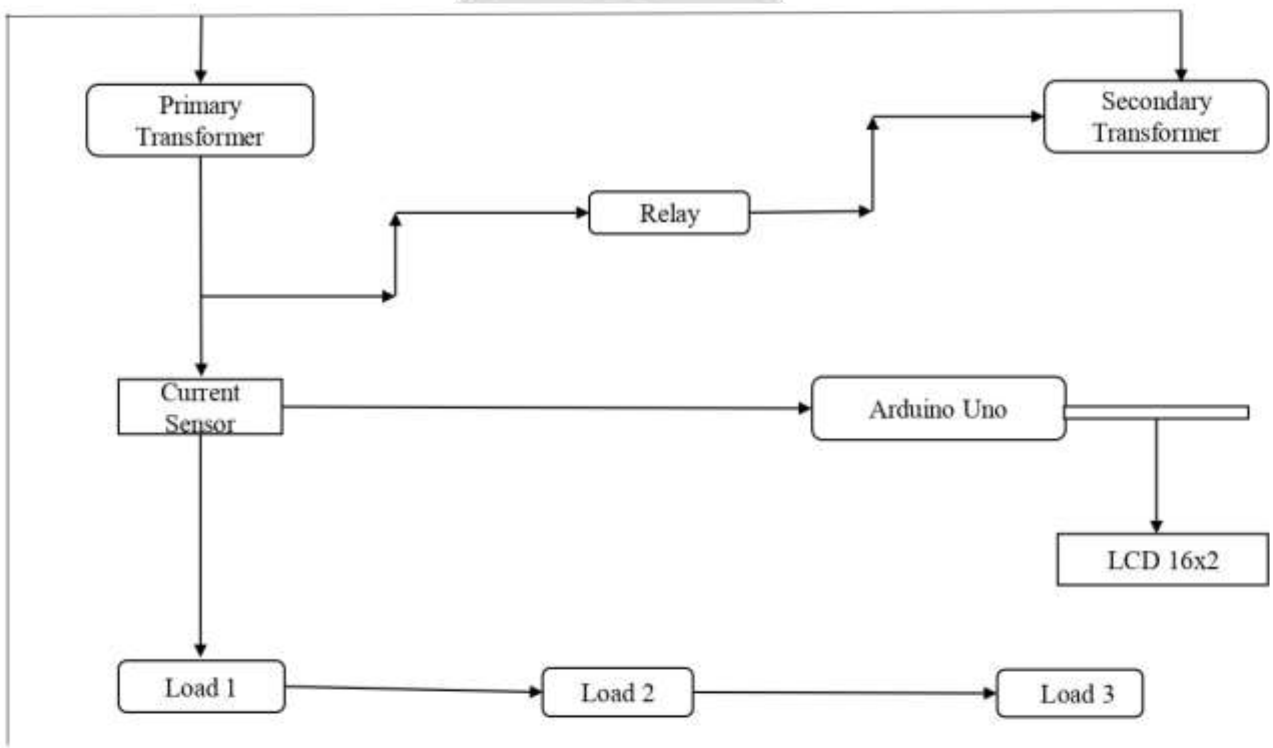

Fig -1 Block Diagram

3. WORKING

Load Sharing Process

In this project we are using the three identical transformers which are connected in parallel through change over relay. Transformer-Tl is a main transformer we called It a master transformer and transformer-T2 is a auxiliary transformer and we called it a slave transformer. Each transformer has its own load handling capacity. In case of a normal operation the master transformer shares the load but as the load is beyond the rated capacity of main transformer the slave transformer is connected in parallel automatically and shares the load. Load switching network is provided to ON/OFF the load on the transformers which is connected to load bank. Shunt is used to distribute the current to all the sections of the circuit. Comparator is having two inputs one is from shunt and the second is from the reference voltage. Reference voltage is set by the user. Comparator compares the reference voltage and system voltage continuously and the output signal is given to the relay driver circuit. Relay driver circuit consists of NPN transistor to drive the relay. Relay driver gives the signal to the changeover relay in case of overload conditions. Change over relay closes its contact when load on the master transformer is more than its rated capacity and the transformer-T2 i.e. slave transformer is automatically connected in parallel with the main transformer. Due to which the transformer-Tl is not overloaded and the problem like overheating, burning of winding of transformer and un-interruption of supply is gets eliminated by this arrangement. The visual indicator contains the LED's which shows the ON/OFF status of all transformers. Firstly, the 230V single phase AC supply is given to the primary of 230 12V stepped down transformer and the 12V is obtained at secondary winding of transformer. This 12V output is given to the bridge rectifier coverts AC into DC. Electronics devices will work properly when they get regulated constant DC power supply for that purpose regulator 7805 is used. The 5 V DC regulated supply is given to the transistor's collector, base (Tr-l). The emitter of n-p-n transistor is connected to the pin number-2 (V-) of the LM-3914 comparator IC. Reference value is set in the preset which is continuously compared with feedback signal. Preset is connected to the pin number 4 & 3 of comparator IC, The MCT-2E is used as a octocoupler. It is a component that transfers electrical signals between two isolated circuits by using light. Octocoupler prevents high voltages from affecting the system receiving the signal. Octocoupler connects the two IC's (i.e., LM3914 comparator IC and ULN 2803 relay driver IC) with each other. Three relays are connected to the pin no. 11, 17 & 18 of ULN2803. The phase of transformers T 1, T2 are connected to the contactor while the neutral is given separately from the single phase supply. Potentiometer of 100K is used as a load which is connected to the secondary side of main transformer T I. Another n-p-n transistor Tr-2 is used for providing the feedback signal to the Tr-l and to make the system automatic. Base of Tr-2 is connected to the potentiometer and the emitter of Tr-2 is connected to the base of transistor Tr-l which is then further applied to the comparator initially, when we switched ON the supply then main transformer Tl is ON and shares the load up to its rated capacity. Now, we gradually vary the load on the transformer Tl by varying the potentiometer. This variation of the load is given to the comparator IC LM3914 continuously by feedback circuit. As the load is increased to such an extent that can't be handled by transformer Tl then this value is compared with the reference or set value by the comparator IC and signal is fed to the relay driver IC ULN2803 for closing of relay contacts. In normal condition the relay contacts are open that's why the transformer T2 is in OFF condition or in other ways they are not part of sharing the load. As the relay-2 closes its contacts the auxiliary transformer T2 is connected in parallel with transformer Tl and shares it's load automatically. When the load is increased and Increased to such an extent that can't be handled by two transformers, then again comparator IC gives the signal to the relay driver IC for closing the contacts of relay. As the relay-3 closes its contacts the transformer is connected automatically in parallel with transformer Tl& T2 and shares the increased load on the system. In this way the automatic load sharing between transformers is done and the protection of transformers against overload is achieved.

4. CONCLUSIONS

If load on one transformer is increased, then the relay will sense the change in current and Arduino operates and slave transformer will come automatically in operation to share load. The work on “Automatic load sharing of transformers” is successfully designed and tested the operation is very smooth and works properly.

5. ACKNOWLEDGEMENT

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6. HARDWARE

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