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Automatic Load sharing of Transformer using Arduino

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Abstract - *Transformer is basically a static device which transfers the electrical power from one circuit to another circuit with desired change in voltage and current at constant frequency. It is only one device which operates at highest efficiency at full load condition. But abnormal condition occurs at overloading condition which may result in severe problem in future. To avoid such condition, we are using other standby transformer which supplies the load when overloading occurs on main transformer unit, which switch on automatically by Arduino. This will result in efficient loading of both transformers. This will avoid the thermal overloading of transformer. The transformer is very costly and bulky equipment of power system. It operates for 24 hours of a day and feeds the load. Sometimes the situation may occur when the load on the transformer is suddenly increased above its rated capacity. When this situation occurs, the transformer will be overloaded and overheated and damage the insulation of transformer resulting in interruption of supply. The best solution to avoid the overloading is to operate the number of transformers in parallel. It is same as parallel operation of transformers where the number of transformers shares the system load. In the suggested approach second transformer will share the load when the load on the first transformer will rise above its rated capacity. The main aim of the work is to provide an uninterrupted power supply to the energy consumers. By implementation of this scheme the problem of interruption of supply due to transformer overloading or overheating can be avoided.*

Key Words: Load Sharing, Overload Protection, Parallel Operation, Uninterrupted Supply, Thermal Overloading.

1.INTRODUCTION

Transformer is basically a static device which transfers the electrical power from one circuit to another circuit with desired change in voltage and current at constant frequency. It is only one device which operates at highest efficiency at full load condition. But abnormal condition occurs at overloading condition which may result in severe problem in future. To avoid such condition, we are using other standby transformer which supplies the load when overloading occurs on main transformer unit, which switch on automatically by Arduino Microcontroller. This will result in efficient loading of both transformers. Also, when load is normal both transformers can be switched on to supply the load alternately. This will avoid the thermal overloading of transformer. Also, this arrangement will provide proper maintenance facility for both transformers. Transformer is a static device which transfers the electrical power from one circuit to another circuit with desired change in voltage and current at constant frequency. Transformer is only one device which operates at higher efficiency at full load condition. But some abnormal conditions occur at overloading conditions. Also, transformer efficiency gets reduced due to increased heating and increased losses. So, it is very essential to share this load other transformer or replace the transformer of higher rating. Later technique is not feasible economically, so the first technique is practically employed to supply load efficiently. We are employing the first technique to supply the load efficiently and reliably. To accomplish this requirement there is one method of manual approach. In this other transformer is connected manually during heavy loading condition. But practically manual approach is not efficient. So, we are employing Arduino to make the switching of transformer automatically. Arduino is an automation-based microcontroller device which will automatically switch the transformer into circuit when overloading condition occur for transformer one. Thus, this will result in efficient working of both transformers. Also, when load is constant both transformers are switched on into the circuit alternately. This will avoid continuous heating of only one transformer. This arrangement offers proper maintenance facility for both transformers. All these advantages will make this system very efficient.

1.1 OBJECTIVE

To develop an Automatic load sharing of transformer by Arduino module to control Load Sharing in the Substation ensure reliability of continue power supply.

To monitor the load on the transformer, depending on the type of load, the TF1 switches ON when the load goes below a predetermined level of load or the TF1 switches OFF when the load is very high.

2. LITERATURE REVIEW

Rekha.T,BinduPrakash,Asna.S,Dinesh.Sand Nandana. S.Prasad (2015), Distribution transformers are an important part of power system which distributes power to the low-voltage users directly, and its operation condition is important for the entire distribution network operation. However, their life is significantly reduced if they are subjected to overloading and over temperature resulting in unexpected failures and loss of supply to many customers thus effecting system reliability. Protection against fault in power systems is very essential and vital for its reliable performance. This project is a simplified approach to protect the transformers from unusual conditions. For this purpose, two similar types of distribution transformers are used so that, if any one transformer fails, then immediately another transformer is brought into the circuit during over loading, over temperatures, input voltage variations and provides conventional 230V supply to the consumers without burning of

transformers. Most of the loads (e.g. Induction motors, arc lamps) are inductive in nature and hence have low lagging power factor. The low power factor is highly undesirable as it causes an increase in current, resulting in additional losses of active power in all the elements of power system from power station generator down to the utilization devices. So, in this paper an automatic power factor correction circuit is also incorporated with the load sharing module.

Ashish R. Ambalkar, Nitesh M. Bhoyar, Vivek V. Badarkhe and Vivek B. Bathe (2015), The transformer is very costly and bulky equipment of power system. It operates for 24 hours of a day and feeds the load. Sometimes the situation may occur when the load on the transformer is suddenly increased above its rated capacity. When this situation occurs, the transformer will be overloaded and overheated and damage the insulation of transformer resulting in interruption of supply. The best solution to avoid the overloading is to operate the number of transformers in parallel. In this work, a slave transformer shares the load of master transformer in the case of overload and over temperature. A sensor circuit is designed to log the data from master transformer and if it is found to be in overload condition, immediately the slave transformer will be connected in the parallel to the master transformer and the load is shared. Initially when we switched ON the load that load will be shared by the first transformer. Once load has been increased on first transformer above its rated capacity then the standby transformer (second) will share the load automatically. In this work we are used a relay and comparator ICs for automatic load sharing between three transformers. The number of transformers to be operated in
parallel can also be increased according to demand of a particular area.

3. METHODOLOGY

The methodology for this project involves the design and implementation of an automatic load sharing system using Arduino to enhance the reliability and protection of distribution transformers. Initially, the system was conceptualized to tackle the issue of overloading in transformers, which often leads to insulation failure, overheating, and potential shutdown of power supply. To address this, a microcontroller-based system was proposed, where an Arduino Uno continuously monitors the load on the primary transformer and automatically engages a secondary transformer when the load exceeds a predefined threshold.
The hardware development began with the selection of essential components, including two step-down transformers for demonstration, relays for switching, and current sensing through a voltage divider mechanism. The Arduino microcontroller acts as the brain of the system, processing input data and controlling the relay operations accordingly. The circuit was initially designed and simulated using Proteus software, which helped verify the working logic and ensure that the switching mechanism functioned properly under simulated overload conditions.
After successful simulation, the hardware circuit was implemented on a breadboard. The Arduino was programmed to read the analog voltage corresponding to the load current and compare it against a set reference value. When the load on the main transformer exceeded this limit, the Arduino activated a relay to switch on the secondary transformer, thus sharing the load and preventing damage. The system was tested with variable loads, and the switching action was observed in real-time using LED indicators and small loads like bulbs. The project successfully demonstrated automatic load management, reduced risk of transformer failure, and ensured uninterrupted power supply during varying load conditions.

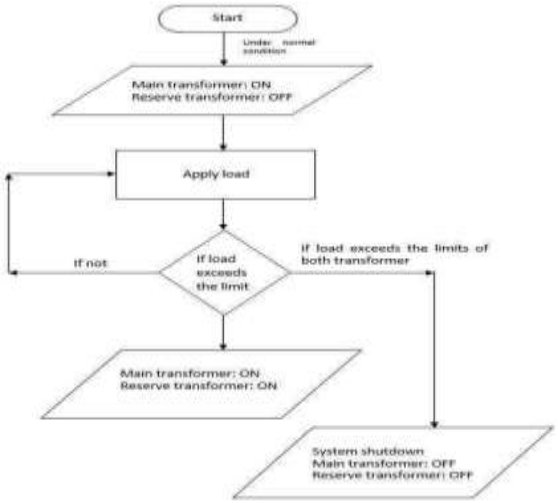

Fig -1: Flow Chart

3.1 CIRCUIT DIAGRAM

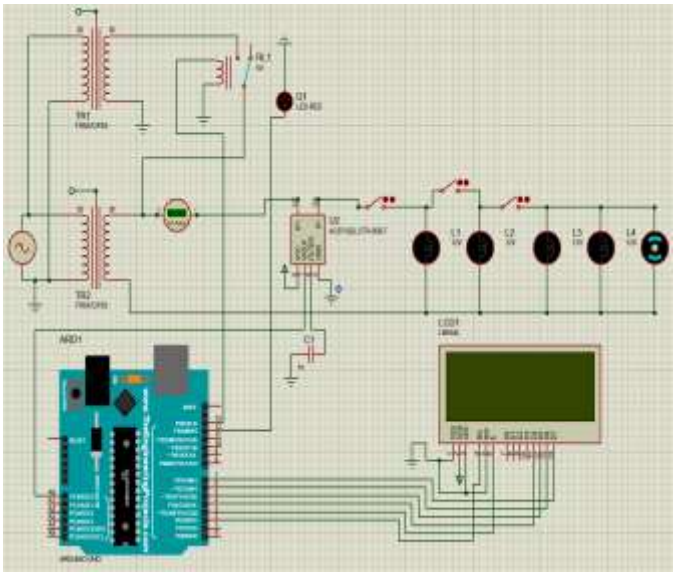

Fig:2 Circuit Diagram

4. RESULT

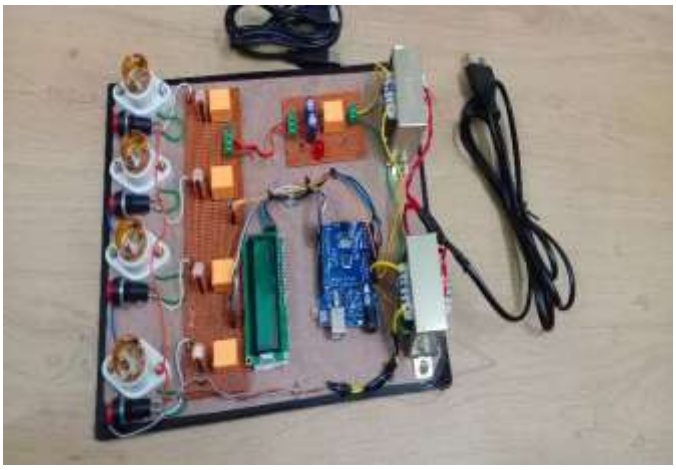

Fig:3 Result

4.1 ADVANTAGES

1) Automatic load sharing by transformers.
2) No manual errors are taking place.
3) It prevents the main transformer from damage due to the like overload and overheats.
4) Un-interrupted power supply to the consumers is supplied.
5) Complete monitoring of transformers.
6) Cost-effective solution using Arduino and basic electronic components.
7) Energy-efficient due to intelligent load management.
8) Improves transformer lifespan by reducing thermal stress and operating within safe limits.

5. CONCLUSIONS

In this project we observed that if load on one transformer increases then the relay will sense the change in current & microcontroller operates & slave transformers comes automatically in operation to share the load. The work on "Automatic load sharing of transformers" is successfully designed, tested and a demo unit is fabricated
for operating two transformers in parallel to share the load automatically with the help of change over relay and relay driver circuit and also to protect the transformers from overloading and thus providing an uninterrupted power supply to the customers.

REFERENCES

1. Dr.J.B.V. Subrahmanyam, T.C. Subramanyam, T.C.Srinivasarao,M.Kalavani and HarithaInavolu, "Auto Control of a Standby Transformer Using Microcontroller", International Journal of Advances In Engineering Research, Vol. 2, Issue 5, pp. 1199-1204, 2011.

2. S.R.Balan, P.Sivanesan, Ramprakash, B.Ananthakannan and K.MithinSubash," GSM Based Automatic Substation LoadShedding and Sharing Using Programmable Switching Control", Journal of Selected Areas in Microelectronics, Volume 6, Issue 2, pp. 59-61, 2014.

3. Ashish R. Ambalkar, Nitesh M. Bhoyar, Vivek V. Badarkhe and Vivek B. Bathe, "Automatic Load Sharing of Transformers", International Journal for Scientific Research & Development, Volume 2, Issue 12, pp. 739-741,2015.

4. Rekha.T,BinduPrakash, Asna. S, Dinesh.S and Nandana.S.Prasad, "An Intelligent Method for Load Sharing of Transformers With Temperature Monitoring and Automatic Correction of Power Factor", International Journal Of Engineering Sciences & Research Technology, Volume 4, Issue3, pp. 416-421, 2015.

5. Hassan Abniki, H.Afsharirad, A.Mohseni, F. Khoshkhati, Has-san Monsef, PouryaSahmsi,,Effective On-line Parameters for Transformer Monitoring and Protection", on Northern American Power Symposium (NAPS), pp 1-5, September 2010.

6. Tong Xiaoyang, Wu Guanging, Zhang Guangehun, Tan Yong-dong „A Transformer Online Monitoring and Diagnosis Em-bedded System Based on TCP/IP and Pub/Sub New Technology", on Properties and Applications of Dielectric Materials, vol 1, pp 467- 470, June2003.