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Automatic Load Sharing and Shading of Transformer

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Abstract: Transformer plays a major role in the power system. It works 24 hours a day and provides power to the load. The transformer is excessive full, its windings are overheated which leads to the judgment of the transformer installation which leads to disruption of the power supply to the load. It takes a lot of time to repair and involves a lot of costs. This project deals with transformer protection under conditions of overcrowding. The transformer could be protected by reducing the additional the transformer's load by connecting and using another transformer in conjunction the primary transformer using a microcontroller and a switch relay. The load on the first transformer is compared to the reference value by the Arduino. When the load exceeds the reference value, the slave transformer is automatically attached to the first transformer and the extra load is shared. Therefore, the number of transformers works well under conditions of overcrowding and damage could be prevented. In this project, slave transformers share the master transformer's duty in the event of overcrowding and overheating. Sensor circuit with Arduino, current transformer, and other components is designed to collect data from the master transformer and if it is determined to be overloaded, the slave transformer is immediately attached to the master transformer and the load is shared. The Arduino keeps track of the transformer's current volume and displays it. If loads are introduced to the current transformer's second side in the second side riser. As the current volume exceeds the estimated current value of the transformer, so the microcontroller sends a travel signal to the relay, thus opening the slave transformer. Initially when we open the load, it will be shared by the first transformer. Once the load on the first transformer has been raised above its maximum capacity, the standby transformer will automatically share the load.

Key words: Transformer, Shading, Sharing

I. INTRODUCTION

Load shedding, load sharing, and other terminology are used in the power system. To begin, we must distinguish between load shedding and load sharing. Shedding loads It is the procedure of cutting-off loads on the approximated region based on load priority in order to connected in parallel with it. The transformers are connected in parallel when the load on one of the transformers exceeds its capacity. The reliability of the electricity grid improves as a result of parallel transformer operation, and damage to various substation equipment, such as transformers, is reduced. Certain requirements must be met in order to archive parallel transformer operation

Power travels from the power plant to house through an amazing system called the power distribution grid. For power to be useful in a home or business, it comes off the transmission grid and is stepped-down to the distribution grid. This may happen in several phases. The place where the conversion from "transmission" to "distribution" occurs is in a power substation. It has transformers that step transmission voltages (in the tens or hundreds of thousands of volts range) down to distribution voltages (typically less than 10,000 volts). It has a “bus” that can split the distribution power off in multiple directions. It often has circuit breakers and switches so that the substation can be disconnected from the transmission grid or separate distribution lines can be disconnected from the substation when necessary.

Transformers being one of the most significant equipment in the electric power system, needs protection as a part of the general system protection approach. Moreover the increasing population and their unavoidable demands have lead to an increasing demand on electrical power. With this increased needs, the existing systems have become overloaded.

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The overloading at the consumer end appears at the transformer terminals which can affect its efficiency and protection systems. Due to overload on the transformer, the efficiency drops and the windings gets over heated and may get burnt. It takes a lot of time to repair and involves a lot of expenditure.

Transformers are occasionally loaded beyond nameplate ratings because of existing possible contingencies on the transmission lines, any failure or fault in power systems, or economic considerations. One of the reported damage or tripping of the distribution transformer is due to thermal overload. To eliminate the damaging of transformers due to overloading from consumer end, it involves the control against over current tripping of distribution transformer.

II. OBJECTIVE OF THE PROJECT

- The main objective of this project is to get continue power supply for agriculture purpose and industrial as well as domestic purpose.
- To design a system that can sense overload condition.
- To protect transformer from damaging due to overloading condition.
- Protect transformers from overloaded condition by sharing the load.
- To measure the current and load in watt of both the transformers

III. PROBLEM DEFINITION

In day today life the demand of electricity is increased. In some areas to provide electricity is very difficult due to high demand of electricity. In agricultural areas or industrial areas due to interrupting of power supply people has to face many difficulties in their routine life. Due to overvoltage condition transformer get damaged and power supply become off. Hence, to overcome that problem we implemented that circuit

IV. SCOPE OF PROJECT

This project aims at designing and implementing an industrial as well as agricultural purposes how to get continuity of power supply.

V. LITERATURE REVIEW

Andure Shivam and et al., (2022) presented the transformer protection under conditions of overcrowding. The transformer could be protected by reducing the additional the transformer's load by connecting and using another transformer in conjunction the primary transformer using a microcontroller and a switch relay. The load on the first transformer is compared to the reference value by the Arduino. When the load exceeds the reference value, the slave transformer is automatically attached to the first transformer and the extra load is shared. Therefore, the number of transformers works well under conditions of overcrowding and damage could be prevented. In this project, slave transformers share the master transformer's duty in the event of overcrowding and overheating. Sensor circuit with Arduino, current transformer, and other components is designed to collect data from the master transformer, and if it is determined to be overloaded, the slave transformer is immediately attached to the master transformer and the load is shared. The Arduino keeps track of the transformer's current volume and displays it.

Vidhun M, and et al., (2017) presented 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.. A GSM modem is also used to inform the control station about switching. The advantages of the project are transformer protection, uninterrupted power supply, and short circuit protection.

K V Shashankkumar, and et al., (2019) presented 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 microcontroller 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

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Shailesh G. Thakre, and et al., (2022) presented the aim of the project is automatic load sharing of transformer under overload condition and protect the transformer from damage and give uninterrupted power supply. Due to overloading the exceeds current flow and windings get overheated and may get burnt hence the efficiency get drops. Thus protect the transformer by sharing loads by connecting another same rating transformer in parallel through a micro-controller. The micro controller compares the load on the first transformer with a reference value. When the load is exceeds then the reference value the second transformer will share the extra load. Therefore the two transformers work efficiently and prevented from damage. In this project three modules are used to control the load currents.

Abhishek Gupta, and et al., (2022) presented 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 like parallel operation of transformers where the number of transformers shares the system load. In the suggested approach slave transformers will share the load when the load on the main transformer will rise above its rated capacity. The main aim of the work is to provide an un-interrupted 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.

Krushna K. Tormad, and et al., (2022) presented the transformer is a primarily stable device which transmits the electric power from one circuit to different circuit with the change in voltage as well as current at stable frequency. It is single device which is work at highest efficiency at full load condition. However, when exceptional condition happen like overloading condition which can result in serious problem in the future. To get away from this condition we are make use of another standby transformer.

This supplies the load when overloading is happen on main transformers, which switch on automatically by use of Arduino. This will result in better efficient loading of both transformers. As well as when load is in normal state both transformers can be switched on to supply the load alternately or one by one. This will keep away from thermal overloading of transformer. As well as this system will provide a proper maintenance facility for both transformers. Whenever the sharing of load on transformer happen, then the operator gets a message through the use of GSM. All of these advantages will make this system very efficient and more reliable. In this way transformer will work efficiently and distribute an uninterrupted power supply.

T.Venkata Sai Kalyani, and et al., (2018) presented 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.

Akhil Krishnan V, and et al., (2016) presented in the power system transformers may be loaded beyond their nameplate ratings due to a fault or some emergency conditions. This type of overloading can cause either short term failures or long term failures. Increase in hot spot temperature would also lead to the accelerated ageing of the transformers resulting in transformer overload. So in order to keep the body temperature of the transformer within its nameplate rating, the transformer must be loaded efficiently in a controlled manner.

VI. METHODOLOGY OF PROJECT

6.1 Parts used in the project: LCD, Power supply, Arduino Nano, Current Sensor, Digital Timer, Relay, Transformer and Load

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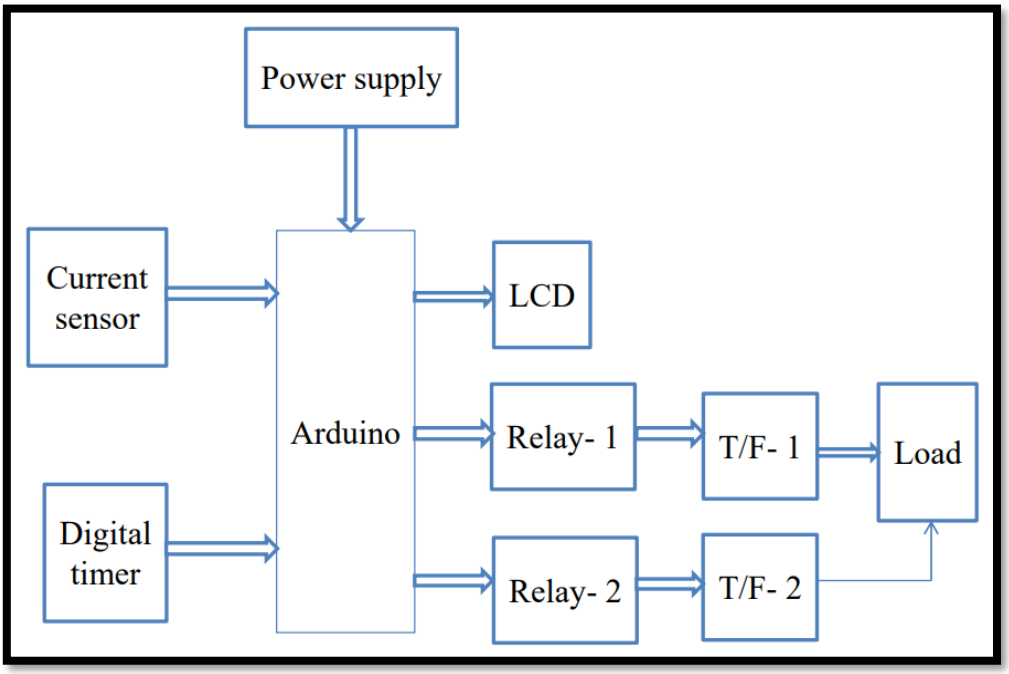
6.2 Diagram of the project:



6.3 Working of the project:

In the proposed system, only one transformer is operating to feed the loads. A standby transformer is connected in parallel through a circuit breaker and relay. The current transformer continuously measures the load current and feeds it to the microcontroller ADC pins. The reference value or the maximum load limit is entered by the user and priority level of the load is also set by the user or concerned authority. As the load demand increase during peak hours, a single transformer would not be able feed all the load. During this condition, when the load demand exceeds the reference value, the microcontroller will give a control signal to energize the relay coil. Thus the standby transformer will be connected in parallel and will share the load equally since the transformers are of the same ratings. Thus all the loads are fed efficiently providing un-interrupted power supply.

The send a message to the control room about the load sharing and a display will be shown in the LCD display. When the load increases further to a value which is greater than the capacity of the two transformers, priority based load shedding will be implemented. The loads which have the lowest priority will be shut down by opening the respective circuit breakers. This message is also sent to the control room. When the load decreases, and comes to normal working condition, first transformer will be shut down in order to avoid thermal overloading. This is done because the first transformer operates for a longer time interval than standby transformer and its body temperature rises. By providing alternative switching, the transformers can be cooled by natural methods. Each time send message about the active transformer thus making load sharing and load shedding efficient.

VII. ADVANTAGES, DISADVANTAGES AND APPLICATION OF THE PROJECT

7.1. Advantages of the project:

- Automatic load sharing by transformers.
- No manual errors are taking place.
- It prevents the main transformer from damage due to the problems like overload and overheats.
- Un-interrupted power supply to the consumers is supplied.
- Complete monitoring of transformers.

7.2. Disadvantages of the project:

- High installation cost
- Maintenance cost high

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7.3. Application of the project

Our project should use for following various applications like as:

- In agricultural areas
- In domestic areas
- In electricity sub-stations
- In MIDC

VIII. FUTURE SCOPE

The project has covered almost all the requirements. Further requirements and improvements can easily be done since the as per requirements is mainly structured or modular in nature. Improvements can be appended by changing the existing modules.

1. The future scope of our project is mainly in substation.
2. There is a need for the operation of an extra transformer at substations, particularly during peak hours, to meet the additional load requirement.
3. Under severe loads, our project automatically connects the transformer. As a result, there is no need to run both transformers at full power, especially during off-peak hours. As a result, electricity is intelligently shared with the transformer in parallel.

IX. CONCLUSION

Transformers are one among the most generic and expensive piece of equipment of the transmission and distribution system. It is known as the heart of the power system. Due to its high cost, the protection and maintenance of the transformer is crucial. With increase in load demand day by day and with existing transformers the load demand is to be satisfied and it may lead to increase in load of each transformer. One of the best solutions of overcoming this is by connecting transformers in parallel. In this project of Automatic Load Sharing of Transformers Using Microcontroller, a technology is implemented to share the load on the transformers. This provides un-interrupted power supply and avoids blackout in particular areas where there is varying loads.

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