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Automatic Load Sharing Transformer with Cutoff System

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Abstract
This project presents the design and implementation of an Automatic Load Sharing Transformer with a Cutoff System using Arduino Uno to improve efficiency, reliability, and protection in power distribution systems. The system automatically distributes electrical load between two or more transformers based on demand, ensuring optimal utilization of available resources. When the load exceeds the capacity of a single transformer, the system activates additional transformers to share the load, thereby preventing overloading and minimizing power losses. The Arduino Uno microcontroller serves as the control unit, continuously monitoring load conditions via current sensors and executing switching operations through relays. Additionally, the system includes a cutoff mechanism that isolates any transformer experiencing a fault or overload, ensuring safety and uninterrupted power supply. This intelligent load management system is especially beneficial in commercial and industrial settings, where power demand frequently fluctuates. The proposed system enhances energy efficiency, reduces manual intervention, and ensures stable power delivery.

Keywords: *Load sharing, transformer protection, Arduino Uno, automatic control, cutoff system, power distribution, overload prevention, energy efficiency, current sensing.*

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I. INTRODUCTION

The efficient distribution and management of electrical power is a fundamental requirement for modern infrastructure. Transformers play a vital role in electrical power systems by stepping down high transmission voltages to usable levels for domestic, commercial, and industrial applications. As the demand for electricity increases due to population growth and technological advancement, transformers are often subjected to varying load conditions. If the load exceeds the rated capacity of a transformer, it may lead to overheating, reduced efficiency, insulation failure, or even complete breakdown. Such failures not only disrupt the power supply but also increase maintenance costs and reduce the lifespan of the equipment.

Traditionally, transformer load management has been a manual or semi-automatic process. Operators monitor the system and manually switch transformers or shut them down when an overload is detected. This method is not only inefficient but also prone to delays and human error. In areas with limited technical staff, particularly in remote or rural locations, it is difficult to respond quickly to such issues. This highlights the need for an automated solution that can intelligently manage transformer loads and protect the system from overloads without human intervention.

The project "Automatic Load Sharing Transformer with Cutoff System Using Arduino UNO" aims to address these challenges by introducing a microcontroller-based automation system. The system uses an Arduino UNO to monitor the current drawn by each transformer in real-time using current sensors. When a transformer reaches its maximum load capacity, the Arduino activates a relay system to either share the load with another transformer or disconnect the overloaded unit, thereby preventing damage. An LCD display provides real-time information about the load status of each transformer. This system offers a cost-effective and scalable solution that enhances the reliability and safety of power distribution. It is particularly useful in decentralized power systems, such as in rural electrification, microgrids, and backup power setups in commercial or industrial sectors.

II. LITERATURE REVIEW

The increasing demand for reliable and efficient power distribution systems has led to significant research in the area of automatic load sharing transformers integrated with cutoff mechanisms. Traditional transformers often face issues such as overload, poor voltage regulation, and unequal load distribution, which can lead to equipment damage and power losses. To address these challenges, researchers have explored the use of embedded systems and microcontrollers, particularly the Arduino UNO, for intelligent load management.

Several studies have focused on designing systems that can monitor transformer load conditions in real-time and automatically switch loads between multiple transformers to maintain balance and prevent overload. These systems typically involve current sensors, relays, and microcontrollers that work together to ensure safe and efficient operation. The Arduino UNO, being a versatile and low-cost microcontroller, has been widely used in prototype models for its ease of programming and interfacing with sensors and actuators.

Research has shown that such automated systems not only improve the lifespan and efficiency of transformers but also enhance the overall reliability of the electrical distribution network. Various implementations have included features such as load cutoff during fault conditions, load sharing between two or more transformers, and alert systems for overload or fault detection. These systems contribute to reduced manual intervention, faster fault response, and improved energy management.

Overall, the literature indicates a growing trend in integrating automation and microcontroller-based control mechanisms in transformer systems, aiming to provide smarter and more resilient power distribution solutions. The Arduino-based automatic load sharing and cutoff systems represent a significant step toward modernizing electrical infrastructure, especially in regions where power demand varies frequently and maintenance resources are limited.

III. METHEDOLOGY

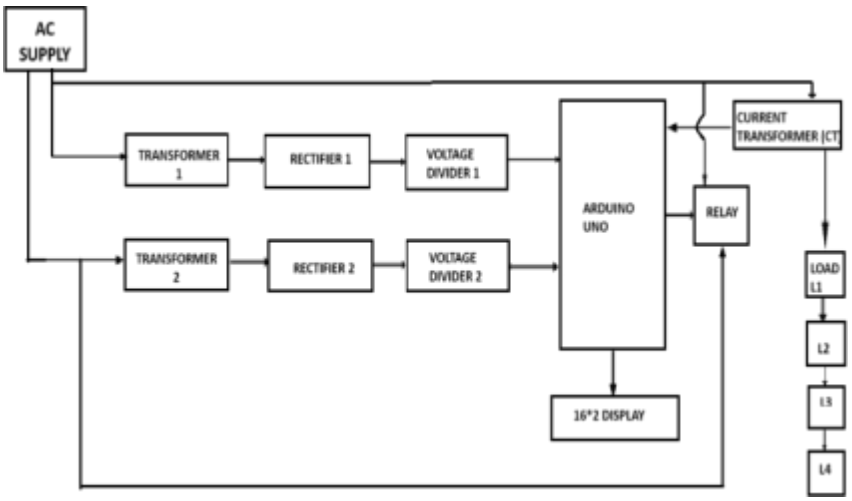

Fig 1 Block Diagram for the Automatic Load Sharing Transformer with Cutoff System

The fig 1 shows the block diagram for the Automatic Load Sharing Transformer with Cutoff System operates by connecting multiple transformers in parallel to the load, with each transformer's connection controlled by relays. These relays are managed by the Arduino UNO, which uses digital output pins to control which transformer is active. Current sensors, such as ACS712, are placed between each transformer and the load to measure the current. These sensors are connected to the Arduino's analog input pins to allow the microcontroller to monitor the load. A regulated DC power supply powers both the Arduino and the relay module, with the Arduino handling load monitoring and transformer control. Additionally, an LCD module displays relevant information, including current readings and transformer status. The system automatically adjusts transformer connections based on current readings, ensuring load sharing and overload protection.

IV. RESULT AND DISCUSSION

Fig 2

Fig 3

The implemented system was tested under various loading conditions to evaluate its performance. During testing, it was observed that the Arduino-based control unit accurately monitored the load on the primary transformer. In fig 2, when the system is initially powered on the Arduino checks the connected load using input from the voltage divider. If the load is within the safe operating range of Transformer 1, the Arduino activates the relay connected to Transformer 1, allowing it to supply power to the load. As a result, only the first bulb (Load L1) turns on, indicating that Transformer 1 alone is handling load efficiently. In fig 3, when the load increases beyond the capacity of Transformer 1, the current transformer (CT) detects the rise in load and sends this information to the Arduino. The Arduino process this data and determines that additional power is needed. It then activates another relay to connect Transformer 2 into the circuit. This results in both transformers sharing the load. Consequently, the second bulb (Load L2) also turns on showing that load sharing is taking place between Transformer 1 and Transformer 2.

V. CONCLUSION

In conclusion, the Automatic Load Sharing Transformer with Cutoff System using Arduino offers a reliable and efficient solution for managing load distribution and transformer protection in power systems. By utilizing Arduino's microcontroller capabilities and integrating key components like current sensors and relays, this system ensures optimal load balancing, overload prevention, and enhanced transformer longevity. The ability to automate the load-sharing process not only reduces the risk of transformer failure but also minimizes the need for human intervention, making the system cost-effective and easy to manage. As the system is scalable and adaptable, it holds significant potential for use in various applications, from industrial power distribution to renewable energy setups. Future advancements, such as the integration of smart grid technologies, machine learning for predictive load balancing, and energy storage solutions, could further enhance its efficiency and performance. Overall, the Automatic Load Sharing Transformer with Cutoff System using Arduino represents a step forward in modernizing power distribution, offering both operational benefits and contributing to sustainability in energy management.

REFERENCES

[1]. M. B. Khadke, A. S. Bansode, et al., "Automatic Load Sharing of Transformers using Microcontroller," International Journal of Engineering Research & Technology (IJERT), vol. 3, no. 4, 2014.

[2]. K. Ramesh, K. B. Ravindra, "Design and Implementation of Load Sharing of Transformer Using PLC," International Journal of Emerging Trends in Electrical and Electronics (IJETEE), vol. 8, no. 1, 2014.

[3]. M. R. Al-Rousan, "Microcontroller-Based Load Sharing of Distribution Transformers," International Journal of Electrical and Computer Engineering, vol. 4, no. 5, 2014.

[4]. A. Kumar, R. Kumar, "Load Sharing of Transformers with Protection using Microcontroller," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 5, no. 3, 2016.

[5]. P. R. Wankhade, R. K. Khaparde, "Voltage Regulation and Load Sharing in Distribution Transformers," IEEE Transactions on Power Delivery, vol. 23, no. 1, 2008.

[6]. P. Kulkarni, M. Shingote, "Design and Implementation of Load Sharing Transformer Based on Load Demand," International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), vol. 2, no. 2, 2016.

[7]. S. Sharma, N. Agrawal, "Microcontroller Based Load Sharing of Transformers," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 3, no. 5, 2014.

[8]. S. Mahapatra et al., "Design of Arduino Based Smart Transformer Load Monitoring System," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, vol. 5, no. 4, 2017.

[9]. M. Prasad, G. Mahesh, "Automation of Transformer Load Monitoring and Control System Using Arduino," International Research Journal of Engineering and Technology (IRJET), vol. 6, no. 3, 2019.

[10]. R. D. Patil et al., "IoT Based Smart Transformer Load Management System," International Journal for Research in Applied Science and Engineering Technology (IJRASET), vol. 9, no. 6, 2021.

[11]. S. Chavan, M. Lande, "Microcontroller Based Automatic Load Sharing of Transformer with Overload Protection," International Journal of Engineering Trends and Technology (IJETT), vol. 13, no. 2, 2014.
[12]. K. S. R. Anjaneyulu, D. Anusha, "Automatic Transformer Load Sharing System using PIC Controller," International Journal of Scientific Engineering and Technology Research (IJSETR), vol. 4, no. 28, 2015.