Transformers Oil Temperature Monitoring with Automatic Circuit Breaker Operation with SMS Alert

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Abstract: *As it transforms high voltages into low voltages for consumption, the distribution transformer is the most crucial part of the power distribution system. If it functions in rated and favourable settings, it can function effectively and for a long time. But, because of excessive current and undesirable conditions, their life was considerably decreased, and the system would experience unexpected breakdowns. Overloading and overheating are the two main causes of distribution transformer failure. The purpose of this project is to develop a microcontroller-based system for distribution transformer safety and online monitoring.*The system enables us to keep track of the oil temperature, shows the fault status, and transmits the input to the GSM module and automatic circuit breaker, which then delivers the data to the control department through SMS alert. At certain time intervals, it monitors the oil level. It automatically disconnects the distribution transformer from the distribution line if it rises or falls above the normal operating level. Many operational issues can be identified before to any catastrophic breakdown, and this will help the transformer have a long service life. Additionally, it benefits from being more reliable and cost-effective.

***Index Terms*— Distribution transformer, GSM module, automatic circuit breaker, and monitoring of oil temperature.**

INTRODUCTION

Distribution transformer is used in good operating conditions, it can last a long time. But because of undesirable circumstances and flaws, they had much shorter lives. They will become overloaded as a result of an excessive load current, which will result in higher losses and unanticipated system breakdowns. These failures and losses will have a negative impact on many consumers and the system. The reliability of the system will be impacted by these flaws. Overloading and transformer cooling are the two main causes of distribution transformer failure.In present times, distribution transformers are operated manually by manpower. Where some persons monitored the transformer on daily basis by visiting the site for recording the parameters of the transformer and its maintenance. Manual monitoring of the distribution transformer cannot provide us instant and complete information about the transformer These factors have a negative impact on the life of distribution transformers. These elements significantly shorten the life of the transformer.

The goal of this project is to develop a system that periodically monitors the temperature and level of the transformer oil online. This system will be able to give us data on a variety of transformer health metrics and its operational state, allowing us to evaluate the parameters and operational state of the transformer over an extended period of time [2]. Several operational issues can be identified before to any catastrophic breakdown of the transformer, which will enable us to extend the transformer's service life. Additionally, it benefits from being more reliable and cost-effective.Based on the desired monitoring system,

I. WORKING OF THE PROTOTYPE

Through the level and temperature sensors, the oil temperature will be regularly monitored at frequent intervals. The collected data will be sent to the microcontroller, which will determine whether it complies with safety standards or if it indicates a malfunction. If the malfunction occurs, the microprocessor will instruct the circuit breaker to isolate the transformer and will also alert the operator. When the oil temperature or level is too high, this GSM module will transmit an alert. The automatic circuit breaker will trip if the temperature or oil level rises beyond a specified range without any humans present.

The microcontroller will be programmed using Bascom-AVR. The GSM module will be configured so that it displays the transformer's name, code, and location.

II. WORKING OF GSM MODULE

The microcontroller sends a message to the GSM modem if the temperature or oil level go above the preset point. These signals include SMS from authorised parties and GSM modem AT commands. The microcontroller will gather all of the sensor data and provide input to the Display. The automated circuit breaker will soon trip as the oil temperature rises beyond the threshold setting [3].

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III. WORKING OF OTHER MAJOR COMPONENTS

A. Arduino Nano

This device utilises an AVR ATmega328 (Arduino Nano 3) due to its adaptability [4]. It is a RISC-based computer with excellent performance and low power. It is quicker than the 8051 and PIC. The microcontroller device communicates with reed switches, voltage sensors, oil level sensors, LCD, 10k thermistor temperature sensors, GSM modules, and LCD [5].

B. Micro-switches

The oil temperature begins to rise as the transformer operates above its maximum rating, expanding the oil volume. The oil will eventually reach its maximum capacity due to expansion. On the first restriction, the suggested monitoring system will alert WAPDA engineers through SMS. The switch will be opened to disconnect the transformer from load when the second limit, which is the maximum value, is exceeded.

C. Bascom

The first Windows Basic compiler for the AVR microcontroller series is called Bascom-AVR [7]. It is a robust and user-friendly compiler made by Atmel. Four programmes from Bascom-AVR are contained in a toolset called the Integrated Development Environment (IDE). Program editors, compilers, programmers, and simulators are all included in them. Such a development environment simplifies the entire procedure, including the microcontroller programming as well as writing and testing programmes. In order to enable the built-in circuit to carry out its functions and reach its objectives, this article writes and burns Bascom directives into the microcontroller flash memory.

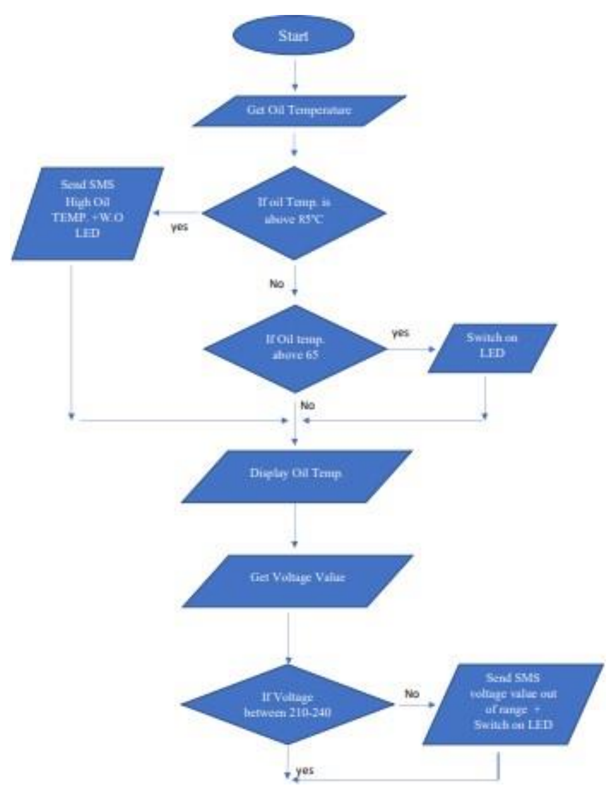
IV. METHODLOGY

A. Block Diagram

It is made up of a power transformer, an oil sensor, a thermistor, an LCD monitor, an ATmega328 (Arduino Nano) converter, a GSM modem, and an automatic circuit breaker. Transformer failure is typically caused by changes in voltage and current, overheating, oil level, etc. To detect these flaws in this assignment, we make use of a microcontroller, temperature sensors, oil level sensors, etc.

The converter is connected to both sensors, and the microcontroller ATmega328 (Arduino Nano) receives the converter's digital output. The Arduino Nano's ATmega328 microcontroller features four ports, including: 1. We will connect to the address block's P1, P2, P3, and P0, the GSM model, and the LCD, respectively. If one of the aforementioned factors causes a problem.

Flow Chart of working of the circuit



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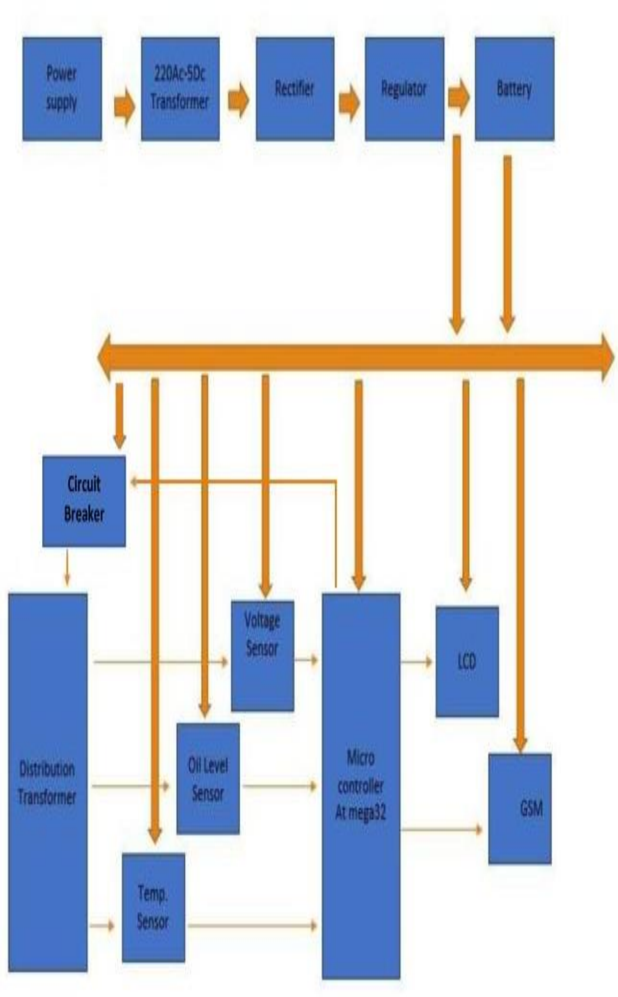

Fig.1. Block Diagram

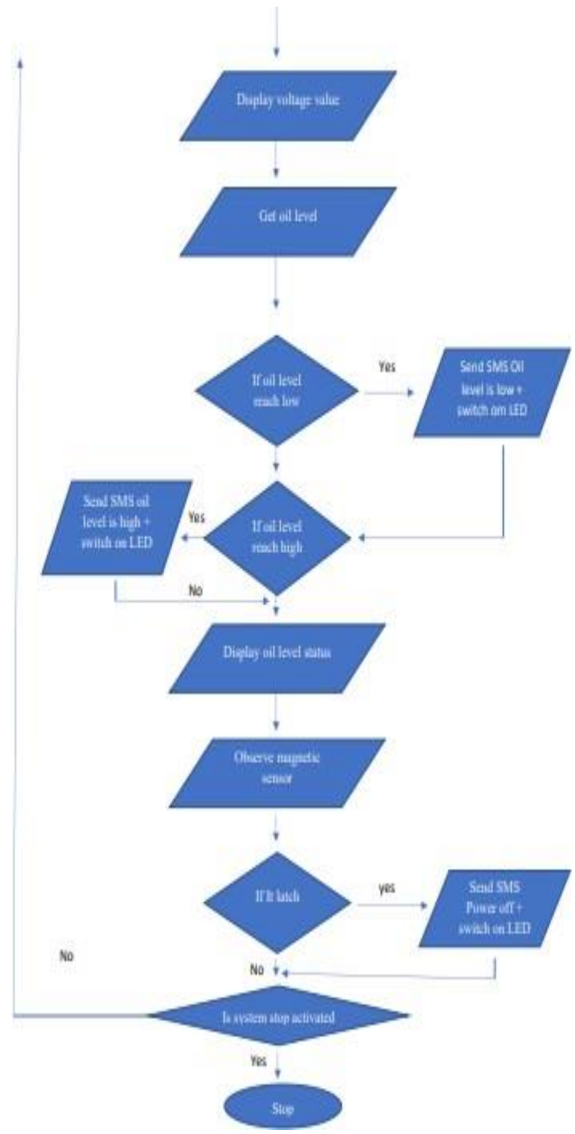

Fig.2. Flow Chart of Project

C. *Components of Project*

The following are the materials utilised in this project:

1. Global System for Mobile Communications (GSM)
2. AURDUINO NANO (ATmega328)
3. LCD (Liquid Crystal Display)
4. ZMPT101B AC Voltage Sensor
5. Magnetic oil level indicator
6. Current Transformer
7. NTC Thermistor 10k
8. Bascom
9. Buck Converter
10. Relay Module
11. 220AC to 5DC Inverter
12. Battery
13. Connecting wires

V. CONCLUSION

It is not only cost-effective but also more efficient to check on the transformer's health daily. Formerly, [1]transformer maintenance was carried out in accordance with a set schedule. Today, when everything is more advanced, we may run the transformer online via GSM technology in remote and developed locations before little problems become dangerous ones thanks to the use of new technologies. This design is specifically made for 500 KVA distribution transformers, and it not only prevents equipment damage but also gives us more system management and reliability.

GSM-based monitoring is extremely helpful and accurate when compared to manual monitoring because it can detect changes in load, temperature, and oil level. Such oversight may result in operations that are efficient and reliable.

i. Minimize human effort, first.
ii. Safeguard the distribution transformer and disconnect from the network.
iii. Extend the life of transformers.
iv. Lower failure rates and raise reliability.
v. Quickly and simply provide more effective Monitoring.
vi. Boost system efficiency.
vii. System automation and digitalization.

VI. RECOMMENDATIONS

Transformer protection is a crucial engineering topic. It goes without saying that as the people and economy rise, so does the demand for electricity. To maintain the consistent power supply required for economic growth in the future, more sophisticated transformer safety techniques must be used. Further changes will be needed in light of the work completed for this project.

i. To further improve the design, a current sensor can be used to determine the transformer's current before measuring its overload value.
ii. This architecture can be improved by including control behaviours in each typical case that calls for a timely response from the controller.
iii. To display its parameters in the HMI, connecting all transformers to the SCADA system may be a feasible solution (HMI).

REFERENCES

[1] A. E. B. Abu-Elanien, M. M. A. Salama and M. Ibrahim, "Calculation of a Health Index for Oil-Immersed Transformers Rated Under 69 kV Using Fuzzy Logic," IEEE Transactions on Power Delivery, vol. 27, no. 4, pp. 2029 - 2036, 2012.

[2] H. Pezeshki, P. J. Wolfs and G. Ledwich, "Impact of High PV Penetration on Distribution Transformer Insulation Life," IEEE Transactions on Power Delivery, pp. 1212-1220, 2014.

[3] M. Yuchun, H. Yinghong, Z. Kun and L. Zhuang, "General Application Research on GSM Module," 2011 International Conference on Internet Computing and Information Services, pp. 525-528, 2011.

[4] T. H. Nasution, M. A. Muchtar, I. Siregar, U. Andayani, E. Christian and E. P. Sinulingga, "Electrical appliances control prototype by using GSM module and Arduino," 2017 4th International Conference on Industrial Engineering and Applications (ICIEA), pp. 355-358, 2017.

[5] A. R. Yeole, S. Bramhankar, M. D. Wani and M. P. Mahajan, "Smart phone controlled robot using ATMEGA328 microcontroller," International Journal of Innovative Research in Computer and Communication Engineering, vol. 3, no. 1, pp. 352-356, 2015.

[6] P. S. Mahardika and A. N. Gunawan, "Modeling of water temperature in evaporation pot with 7 Ds18b20 sensors based on Atmega328 microcontroller," Linguistics and Culture Review, vol. 6, pp. 184-193, 2022.

[7] C. Kuhnel, BASCOM Programming of microcontrollers with ease: An introduction by program examples, Universal-Publishers, 2001.

[8] R. Rengaraj, G. Venkatakrishnan, P. Moorthy, R. Pratyusha, K. Veena and a. others, "Transformer Oil Health Monitoring Techniques—An Overview," {Advances in Smart System Technologies, pp. 135-154, 2021.