International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 321-325 www.ijaem.net ISSN: 2395-5252

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

Amol Rajendra Gutal[a], Vaibhav Onkar Bagade[b], Mahesh Mohan Hembade [c], Omkar Dattatray Jadhav [d]
Under The Guidance:- Prof. Rupali. R Bairagi.
Department of Electrical Engineering Savitribai Phule Pune University of Engineering and Technology, Pune

Date of Submission: 01-05-2023 Date of Acceptance: 10-05-2023

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.

I. 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 operatedmanually by manpower. Where some persons monitored thetransformer on daily basis by visiting the site for recording theparameters of the transformer and its maintenance. Manualmonitoring of the distribution transformer cannot provide usinstantandcompleteinformationaboutthetransformer

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].

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.

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.

II. METHODLOGY

A. Block Diagram

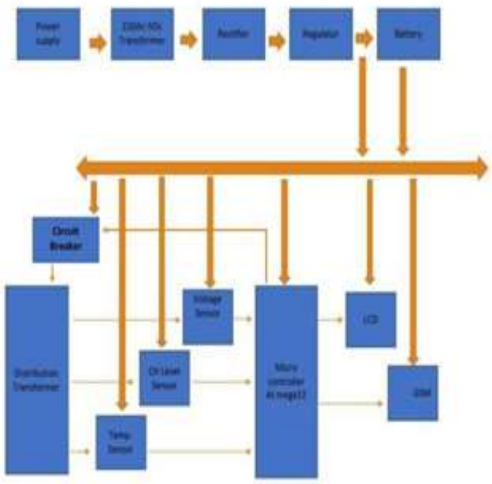

Fig.1.Block Diagram

FlowChart of working of the circuit

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 321-325 www.ijaem.net ISSN: 2395-5252

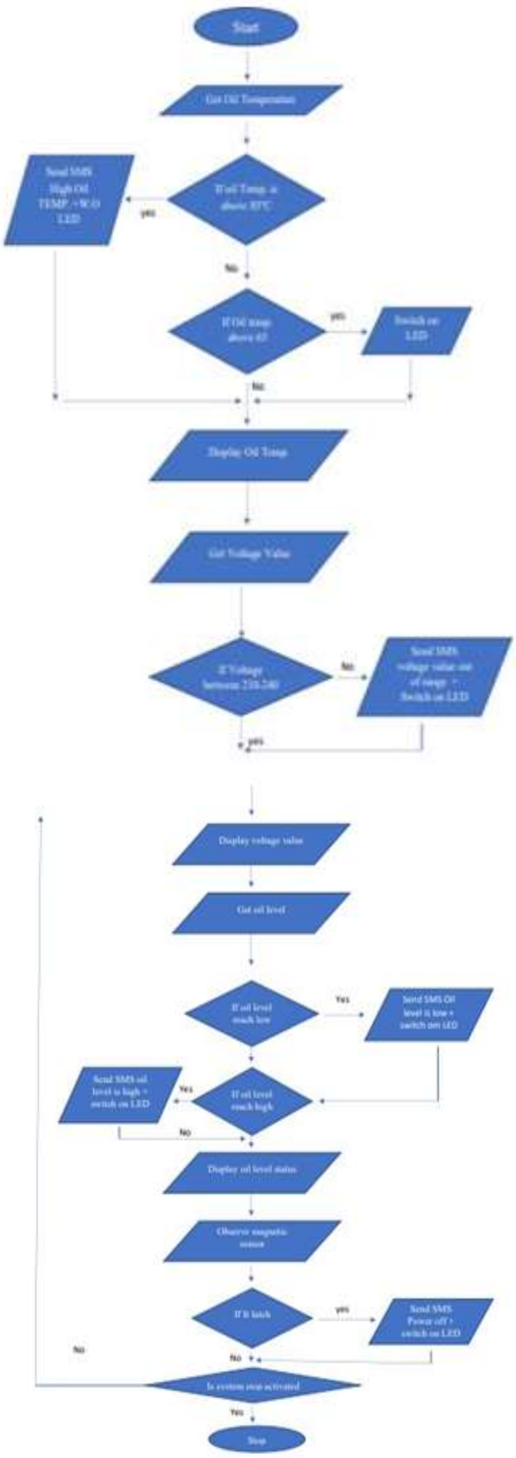

Fig.2.Flow Chart of Project

C. ComponentsofProject

The following are the materials utilised in this project:

1. GlobalSystem forMobileCommunications(GSM)
2. AURDUINONANO(ATmega328)
3. LCD(LiquidCrystalDisplay)
4. ZMPT101BACVoltageSensor
5. Magneticoillevelindicator
6. Current Transformer
7. NTCThermistor 10k
8. Bascom
9. Buck Converter
10. RelayModule
11. 220ACto 5DCInverter
12. Battery
13. Connectingwires

D. Prototype Model

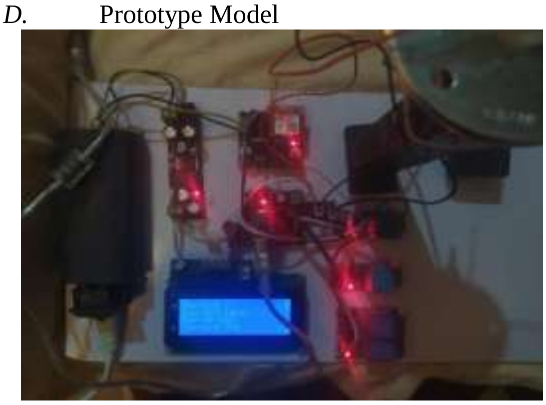

Fig.3.PrototypeModel

III. DISCUSSION AND RESULTS

The transformer status will be shown on the display as a result of the microcontroller receiving the analogue input signal from the circuit design and converting it to a digital signal. The transformer's value is initially fixed, and if it rises over this value, the LED is activated and an SMS is sent to the mobile user who is simultaneously providing the GSM modem number [6, 8].

There are various situations with various circumstances. These are a few examples of various flaws and prototype results.

A. Case01: LowOilLevel

A low-level sensor, which is represented in the circuit by a low-level button, will detect when the oil level in the transformer is low. Then a text message stating "Oil Level is Low in Tran" along with the LCD display of "O: Low" and an LED indicator will be sent to the designated recipient. as depicted in picture 4.

Fig.4. Figoflowoillevel

B. Case02:High OilLevel

The high-level sensor, which is represented by the high-level button in the circuit, will detect a high oil level in the transformer. Oil Level is High in Tran is the text message, and "O: High" and "Reduce the Load" are shown on the LCD panel as illustrated in figure 5.

Fig.5.High Oil Level

C. Case03:OilTemperatureHigherthan85°C

The Thermistor 10k will detect an increase in oil temperature in the transformer if it rises beyond 85°C, and the temperature is expressed in terms of temperature. Web-based sensor. The warning will be displayed on the LCD as seen in fig. 4.4. "Tran: High oil temperature and supply is shutting off," reads the text.

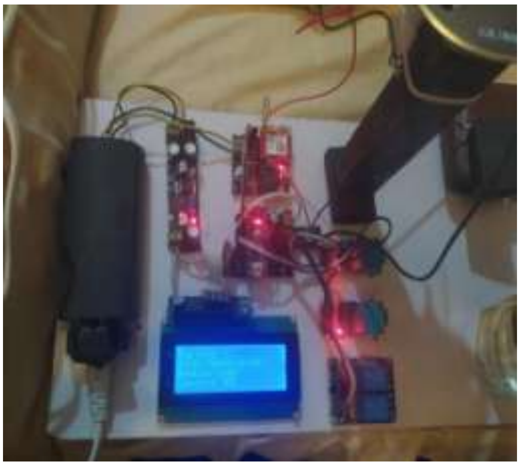

Fig.6.High OilTemperature

Thermistor 10k will detect an increase in oil temperature in the transformer if it rises beyond 65°C, and the temperature is expressed by a temperature, online sensor. The warning will be displayed on the LCD as shown in fig. 6. "Tran: High oil temperature reduced the load," reads the text message.

To make the system dependable and to provide the user more control, an automatic circuit breaker will trip when the value of any parameter is above the specified range.

IV. 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 andsimply provide more effective Monitoring.
vi. Boost system efficiency.

vii. System automation and digitalization.

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,"CalculationofaHealthIndexforOil-ImmersedTransformers 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 ofHighPVPenetrationonDistributionTransformerInsulation Life," IEEE Transactions on Power Delivery,pp.1212-1220,2014.

[3] M.Yuchun,H.Yinghong,Z.KunandL.Zhuang, "General Application Research on GSM Module," 2011InternationalConferenceonInternetComputingandInformation Services, pp. 525-528,2011.

[4] T.H.Nasution,M.A.Muchtar,I.Siregar,U.Andayani, E. Christian and E. P. Sinulingga, "Electrical appliancescontrol prototype by using GSM module and Arduino,"20174thInternationalConferenceonIndustrialEngineeringandApplications(ICIEA),pp.355-358,2017.

[5] A.R.Yeole,S.Bramhankar,M.D. WaniandM. P.Mahajan,"Smartphonecontrolledrobotusing ATMEGA328 microcontroller," International Journal ofInnovativeResearchinComputerandCommunicationEngineering, vol. 3,no.1,pp.352-356,2015.

[6] P. S. Mahardika and A. N. Gunawan, "Modeling of watertemperature in evaporation pot with 7 Ds18b20 sensorsbasedonAtmega328microcontroller," Linguistics andCultureReview,vol. 6,pp.184-193, 2022.

[7] C. Kuhnel, BASCOM Programming of microcontrollerswithease:Anintroductionbyprogramexamples,Universal-Publishers,2001.

[8] R.Rengaraj,G.Venkatakrishnan,P.Moorthy,R.Pratyusha,K.Veenaanda.others,"TransformerOilHealthMonitoringTechniques—AnOverview,"{Advances in Smart System Technologies, pp. 135-154,2021.