Distribution Transformer Fault Detection and Protection Based on IoT

Elumalai R[1], Manavalan K[2], Muthu Kumar P[3], Dr. V. Anitha[4], P. Vanitha[5]
[1, 2, 3] Dept of Electrical And Electronics
[4]HOD, Dept of Electrical And Electronics
[5]Assistant Professor, Dept of Electrical And Electronics
[1, 2, 3, 4, 5] Sri Muthukumaran Institute of Technology

Abstract- *Monitoring and protecting the distribution from winding deformation is a common problem that takes place within operating power transformers due to various internal and external conditions. Due to their progressive nature, winding deformations should be detected and rectified as soon as they emerge. Unfortunately, the only reliable technique to detect such faults at this stage is the frequency response analysis which is conducted offline. In this project, we are proposing an idea to detect power transformer incipient winding deformations in real time through measuring current level in transformer. In this technique, we are monitoring the live status of transformer using low cost and easily available sensors. Health condition of the distribution transformer updated lively in web server using IOT technology.*

Keywords- Monitoring, analyzing, fault detection, protection of Distribution Transformer

I. INTRODUCTION

In today's world, the power system network of a smart grid holds the prime importance because of the high demand of quality power supply. It is usually done by deploying multiple approaches for monitoring, protecting and controlling mechanisms. In distribution networks, the distribution of transformer is an essential part. In the point of view of Libyan, the power system network can be monitored by such systems, which can be controlled in a certain degree.

The average life of transformers is 20-25 years. [1]. The transformers are mainly installed when their operational life is about to end. The monitoring methods currently being used are related with electrical parameters and those parameters does not give any idea about the condition of the distribution transformer internally. For such an important asset in power system, periodical maintenance is not sufficient. An online monitoring system is required, which base on the conditions to maintain the transformers. The condition of the equipment will be monitored remotely, in the meantime a maintain and control schedule can be arranged in real time. In a similar way, before making a proper decision, condition monitoring techniques use different parameters, both internal and external that are linked to a transformer, to predict its status of operation. Based on the severeness which is the main feature in asset management, the decision can be used to schedule maintenance or removal and replacement. But existing monitoring device systems used for monitoring distribution transformer has some insufficiencies The system used for detection is very inconsistent. The performance of a system depends on multiple factors such as un stability of a device, jamming capability of a device, result of accuracy in data when data is measured is low or there is no affect on another system. The measurement system for a transformer only measures one parameter of a transformer such as current, voltage, power and phase. There are ways which detect more than one parameter, but the speed of testing is not so fast and it takes more time and operation parameters are long to handle with such speed. Three-phase equilibrium of distribution transformers cannot be judged because monitoring centers will receive the detection data late.

II. LITERATURE SURVEY

INTRODUCTION

The literature review of the distribution transformer monitoring and protection is explained below with references from IEEE Conference Publications, International Conference Publications.

LITERATURE STUDY

Lokesh Y.Sonwane; K. Kamal Sandeep; Pramil Wakchaure "Interterm Fault Detection in Transformers Using Search Coil Based Method": 2018 International Conference on Recent Innovations in Electrical, Electronics & Communication Engineering (ICRIEECE).Transformers play a vital role in electrical power systems and early detection of faults can prevent its breakdown. Interterm faults account to majority of failures in a transformer. An effective method based on search coils is hence presented in this paper to detect interterm fault. The symmetry of leakage flux pattern can be

studied using these induced voltage search coils and its analysis can provide information about any incipient fault. Fault location can also be determined with this method. This paper also includes design calculations for 1kVA, 440/440, Delta-Star distribution transformer under study.

Hongzhi Ding; Richard Heywood; John Lapworth; Richard Josebury; Andrew Roxborough; Elaine McCulloch "Practical experience of dissolved gas in transformer oil for the detection of incipient faults"2017 IEEE 19th International Conference on Dielectric Liquids (ICDL).Although the association between dissolved gas analysis (DGA) in transformer oil and incipient faults is well established, interpretations for this association are not. There are different approaches to the interpretation of DGA results, some standards use individual gas limits while others use key gases or ratios (such as Rogers). Different with numerous publications on the subject presented about DGA interpretation techniques that are available for the detection of incipient faults, this paper has addressed how we meet the challenges in real cases and introduce experience learnt in implementing DGA diagnostic approaches to "look after" each fault-specific transformer. Some key learning points are when properly applied, DGA signature is powerful for detecting a wide range of incipient faults in transformers and assisting in determination when to remove the transformer from service for repair or replacement. Knowledge of transformer design strength and weakness together with information of historic operation and maintenance enable the results of DGA to be interpreted correctly and Utilizing these practical experiences allow the user to manage the risk of failure and discount the need for replacement. Gang Zhang;Tao Guo;Jiejun Liu "Implementation of business rules approach in transformer fault detection system"2012 7th International Conference on Computer Science &Education (ICCSE). In present electric power system, signal feedback approach is used in fault detection system of power transmission and transformation devices. Each monitor station controls a huge number of devices. Fault information is delivered to workers by displaying on the screen. The high refresh rate of prompted messages on screen and the long duration of decision-making will result in the loss of important fault information. In order to address that problem, we developed a transformer fault detection system by adopting rule-based programming approach based on the transformer's fault detection in electric power transmission and transformation. This system can help workers analyse the fault information and take corresponding operations. In order to let user maintain business rules base independently, we developed business rules management system. In this paper, it shows that rule-based approach can be applied in fault detection, and it reduces worker workload greatly. The implementation of rule management system indicates that users can maintain rule base independently. If the system defines a definite definition of conflicts in rule base, it can automatically detect the existence of conflict rules. Salman Hajiaghasi; M. Milad Hosseini Ahmadi; Z. Rafiee; Ahmad Selemnia"Transformer Leakage Flux Frequencies Analysis under Internal Windings Faults"2019 27th Iranian Conference on Electrical Engineering (ICEE).Inter-turn winding faults are one of the most important faults occurs in transformers and if it not quickly detected, develop into serious faults that would result in harmful damage to transformer. In this paper, the effects of leakage flux variation under inter-turn winding fault conditions are studied. To analyse the transformer behaviour under inter-turn winding faults, a three phase transformer with actual dimensions is modelled using time stepping finite element method (TSFEM). For experimental investigation of leakage flux, four search coils are installed on the HV windings of the transformer and the frequency spectrum of search coils are analysed. Search coils signature analysis for various situations of inter-turn faults and transformer operation are extracted. The obtained results show that leakage flux analysis can be used as an attractive and reliable method for transformer interterm fault detection.

III. EXISTING SYSTEM

According to statistical data, winding deformation represents the main failure mode in the current worldwide power transformer fleet. The current conventional techniques to detect transformer winding deformations including sweep frequency response analysis (SFRA), short-circuit impedance (SCI) and low-voltage impulse (LVI) are of offline nature that call for the disconnection of the power transformer for testing. The main advantage of proposed technique over other techniques is that the V-I technique is conducted in online and does not call for additional equipment or sensors as it utilizes the existing metering devices attached to power transformers.

IV. DISADVANTAGES

- Currently employed detection techniques are of offline.
- Disconnection of the transformer is required for fault analysis.
- May lead to increase in time delay to repair.

V. PROPOSED SYSTEM

The proposed system consists of one crucial input sections namely, current sensing unit. These unit continuously measure the amount of current in transformer respectively. Output values from these units are sent to microcontroller that compares output values with predetermined range of values.

Both output values and comparison result are updated to central monitoring unit through Internet of Things (IoT). If output values cross predetermined range to some extent, an intimation will be sent monitoring section with location and the same will be updated in Webserver using IOT.

It is also important to monitor the condition of transformer. For that, some sensors are incorporated with the controller to monitor live status of transformer. Humidity sensor is used to measure amount of humidity in the transformer, oil level sensor is for measuring the level of insulation oil. If any abnormal values occurred buzzer turns on. Using three loads in this prototype model to demonstrate the priority-based load scheduling.

VI. ADVANTAGES

- Real time monitoring can be done.
- Time delay can be reduced for repair due to continuous monitoring.

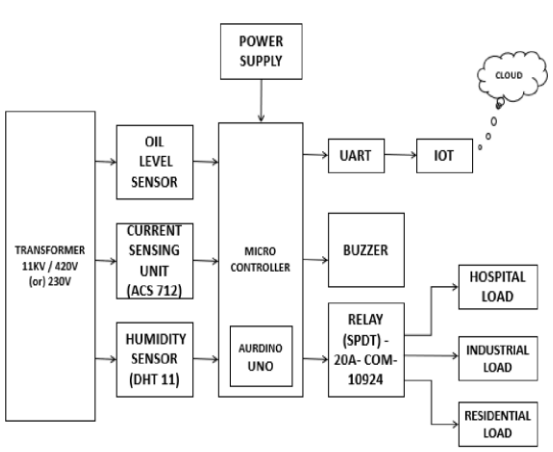
VII. SUMMARY

The paper in the background study helped in understanding, analysing, monitoring and protection of the Distribution Transformer, also the important of monitoring and how protecting the present applications which is highly reliable and beneficial. The system which is already in existing not a portable one, even though the portable cannot be used effectively

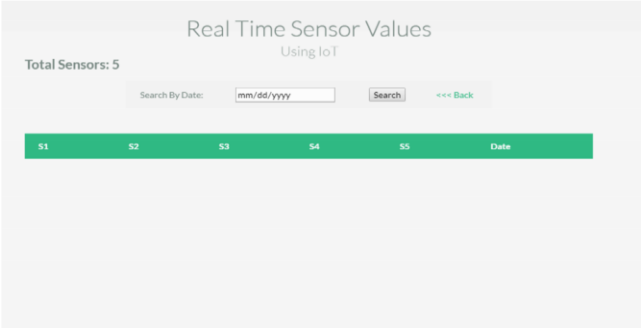
DESIGN AND MODELLING OF PROJECT

Based on the various literatures analysed, to overcome the drawbacks present in the existing system was proposed. The block diagram of the proposed system has been discussed in detailed in this chapter.

VIII. BLOCK DIAGRAM



WEB SERVER



IX. CONCLUSION

The model design in such a way to solve the problems faced by consumer. By using such method, we can easily detect the fault and resolve it. It is highly reliable and locate the fault in three phase transmission line and also supposed to data storage. It works on real time so we maintain all data sheet and avoid the future problem in transmission line.

REFERENCES

[1] W. H. Bartley, “Analysis of Transformer Failures”, in International Association of Engineering Insurers, pp. 1-12, Stockholm, 2003.

[2] X. Zhang and E. Gockenbach, “Asset-management of transformers based on condition monitoring and standard diagnosi,” IEEE Electr. Insul. Mag., vol. 24, no. 4, pp. 26-40, 2008.

[3] K.P. Badgujar, M. Maoyafikuddin and S.V. Kulkarni, "Alternative statistical techniques for aiding SFRA diagnostics in transformers," IET Generation, Transmission & Distribution, vol.6, no.3, pp.189-198, March 2012.

[4] N. Yadaiah and N. Ravi, "Fault Detection Techniques for Power Transformers," 2007 IEEE/IAS Industrial &

Commercial Power Systems Technical Conference, Edmonton, Alta., pp. 1-9, 2007.

[5] Guzman, N. Fischer, and C. Labuschagne, "Improvements in transformer protection and control," 62nd Annual Conference for Protective Relay Engineers , pp. 563-579, March 2009.

[6] H. Wang and K. L. Butler, "Modeling Transformers with Internal Incipient Faults", IEEE Trans on Power Delivery, vol. 17, no. 2, pp. 500- 509, 2002.

[7] K. L. Butler-Purry and M. Bagriyanik, "Identifying transformer incipient events for maintaining distribution system reliability," Proceedings of the 36th Annual Hawaii International Conference on System Sciences, 2003.

[8] A. Abu-Siada and S. Islam, "A novel online technique to detect power transformer winding faults", IEEE Trans. Power Del., vol. 27, no. 2, pp. 849-857, Apr. 2012.

[9] P. A. Venikar, M. S. Ballal, B. S. Umre and H. M. Suryawanshi, "Sensitive incipient inter-turn fault detection algorithm for power transformers", IET Elect. Power Appl,. vol. 10, pp. 858-868, 2016.

[10] M. F. Cabanas et al., "A new online method based on leakage flux analysis for the early detection and location of insulating failures in power transformers: Application to remote condition monitoring", IEEE Trans. Power Del., vol. 22, no. 3, pp. 1591-1602, Jul. 2007.

[11] P. A. Venikar, M. S. Ballal, B. S. Umre and H. M. Suryawanshi, "Search Coil Based Online Diagnostics of Transformer Internal Faults," in IEEE Transactions on Power Delivery, vol. 32, no. 6, pp. 2520-2529, Dec. 2017.

[12] P. A. Venikar, M. S. Ballal, B. S. Umre and H. M. Suryawanshi, "A novel offline to online approach to detect transformer interturn fault", IEEE Trans. Power Del., vol. 31, no. 2, pp. 482-492, Apr. 2016.

[13] Lokesh Y. Sonwane and K. Kamal Sandeep, "Design and Development of Interturn Fault Identification System for Transformer", Proceedings of the 2nd International conference on Electronics, Communication and Aerospace Technology (ICECA), pp. 94-98, 2018.

[14] Z. Gajic, I. Brncic, B. Hillstrom, F. Mekic and I. Ivankovic, "Sensitive turn-to-turn fault protection for power transformers", Proc. CIGRE Study Committee B5 Colloq., 2005.

[15] T. Ghanbari and A. Farjah, "A magnetic leakage flux-based approach for fault diagnosis in electrical machines", IEEE Sensors J, vol. 14, no. 9, pp. 2981-2988, Sep. 2014.