Smart Maintenance System for Distribution Transformer

Yogeshwar J[1], Varshith V[2], Meghana S K[3], Keerthana R[4]

[1-4]*Department of ISE, Vidyavardhaka College of Engineering, Mysore, India*

Abstract — one of the most important equipment in the power grid and distribution system is the Transformer. Since in current electrical systems a large number of transformers are spread over a wide area, it is difficult to manually control the condition of each single transformer, separately. Automatic data collection and condition monitoring of transformers was therefore an important requirement. Various methodologies have been implemented to make the process online using various different technologies. The paper discusses the different efforts made to make the process online and control it remotely.

Keywords- Distribution transformer, GSM, smart relays, Voltage, current, IOT, micro-controllers.

1. INTRODUCTION

Recent years have seen increased emphasis on power reliability and economy. In particular, major changes in the utility sector have given rise to greater interest in more economical and reliable methods of generating, transmitting and distributing electric power. Distribution Transformer is a vital power-system equipment. The power system's efficient operation relies upon the distribution transformer's successful functioning. Any malfunction of this item will affect the performance of the network as a whole and may also have considerable economic effects on the system. As a result, methods for mitigating the transformer's ageing and loss of life (LOL) are studied extensively to make this essential part of the electrical network more sustainable and, consequently, to ensure the sustainability of the entire system. Monitoring of the major parameters of the transformer such as voltage, current and temperature is therefore important to assess the output of the distribution transformer and also helpful in preventing or reducing disruption due to sudden unexpected catastrophic failure.

The present method for monitoring of distribution transformer has the following drawbacks:

a) In the events of equipment failure, operations are done manually

b) Time consuming

c) Demands a lot of labour work

d) The production process is also extremely affected.

By implementing centralized monitoring, the operation of distribution networks and their reliability can be significantly improved. The phenomenal advantages of the wireless communication technology such as reliability, speed, convenience and low transmission costs can be realized using a centralised monitoring system. Hence, the remote monitoring of the parameters of the transformer such as load, current, voltage, temperature is very essential, as it mitigates the loss of life of the transformer and also the economic impact on the whole system.

2. METHODOLOGIES

A. GSM technique for communication

Prof. M.S. Sujatha and Dr. M Vijay Kumar suggest a technique based on the Robust GSM system that meets the reliability of protection and is the fastest in operation. It consists of a sensing system , electronic circuits for signal processing, sophisticated embedded hardware for middle-level computing, and a powerful computer network for further data transmission to different locations. The aforementioned system can communicate with one grid and its related actions that follow. This system is an Advanced intelligent Electronic device (AIED). To render a complete and perfect grid control system, the entire system must be used.

The Sub elements of proposed system are

• Sensing Transformers.

• Signal Conditioners.

- Embedded based electronic Hardware.
- GSM technology for Data transfer.
- Powerful software to generate control signal

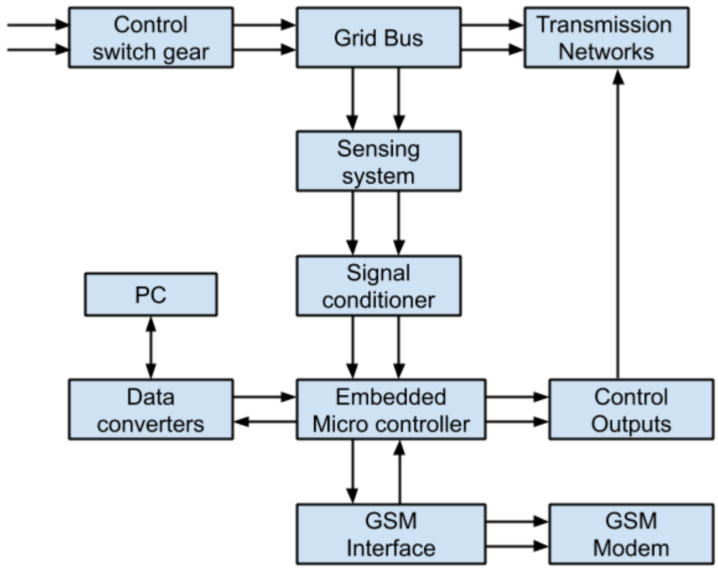

Fig 1: Block diagram of robust communication based SPS for power system

B. FGPA based technology

Jaswinder Singh and S.K. Aggarwal introduces the Distributed Transformer Monitoring System (DTMS) using FPGA-based, integrated communication module technology and its use for Smart Grid. It consists of sensor network, energy meter network, and wireless network communication. The entire system architecture and the system's hardware & software flow were explained. The defined method efficiently tracks the operating state of the network of transformers, dispatches the vital information to personal maintenance, so they can take appropriate action to prevent disruption. The system analyses the data to predict the transformer's load and life. On the implemented testing system, a trail was given, and results came out as expected.

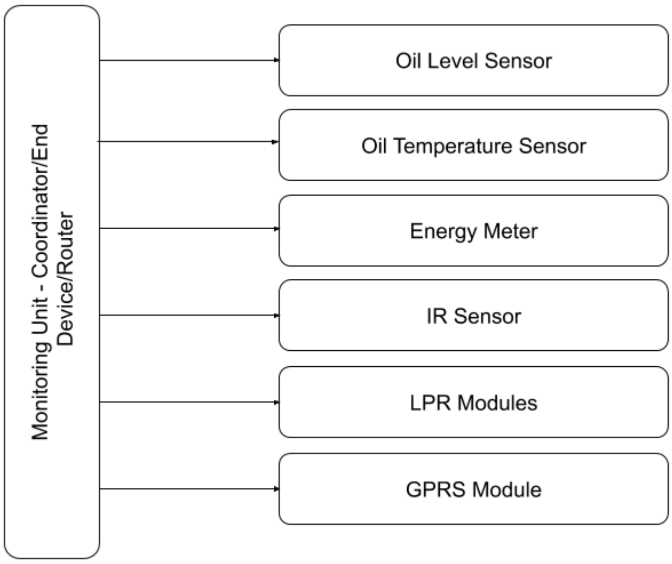

Fig 2. Structure of DTMS

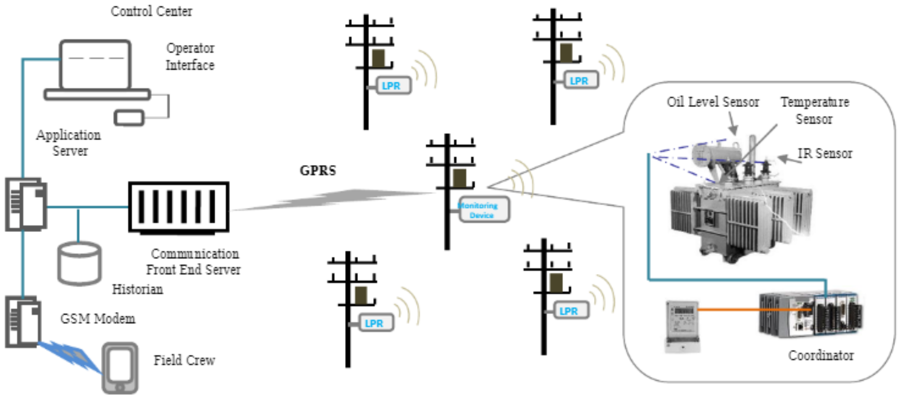

Fig 3. Field Implementation

C. Using Rasberry-Pi microcontroller

Priyanka R, Chaithrashree N, Sangeetha S,Bhagyalakshmi, Divyashree A proposes, through the Raspberry-Pi module, the design and implementation of Real Time Transformer Health Monitoring System (THMS). In the case of a software controlled system, the complete system needs a lot of communication and equipment as well as technically trained personnel. On the other hand, the built device has less deployment difficulty and needs no professional staff, and can be notified remotely. THMS main feature is automatic decision making. They got their system divided into four sections. They are data gatherer, data generator, data processor and part of contact. The data collector unit is multiple sensors modules situated at the transformer site. The transformer side is used to acquire the data points. The data converter unit contains an ADC for process conversion. In the Raspberry chip the transformed information is then analysed and weighed. The IOT module is connected in the communicating part. This module uses Twilio cloud server to transmit information from the transformer to the monitoring system. An operator can take steps in the message receiving section by reading the message about what kind of fault occurs. The Raspberry chip can thus isolate the faulty transformer even before a huge accident occurs.

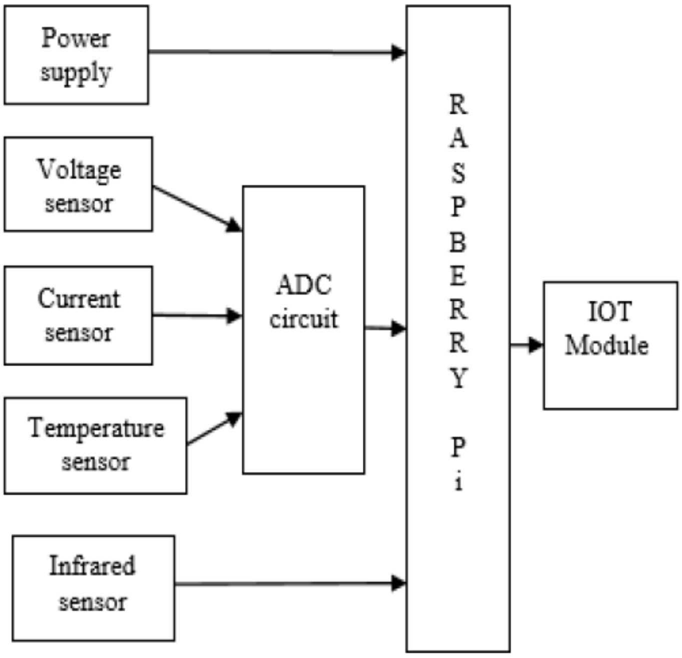

Fig 4. Block diagram of Raspberry-pi based THMS

D. DTMS using MQTT

Tarun Kanti Roy and Tusher Kanti Roy proposes an approach where they use MQTT message protocol instead of HTTP protocol. MQTT is a lightweight messaging protocol designed for high latency for the limited and small sensor networks. MQTT protocol mainly leverages background client-server communication details — sends transformer diagnostic data to server and receives operator commands. When it comes to push and quality service, MQTT holds an upper hand compared to HTTP. The MQTT publish/client API on ATMEGA328 is implemented in this project to achieve bidirectional communication with gateway servers. The Sensors takes the readings from the transformer and sends it using MQTT protocol to the server. The website or mobile application reads the data received and predicts the problem which may occur. This is used to take preventive measures in the future.

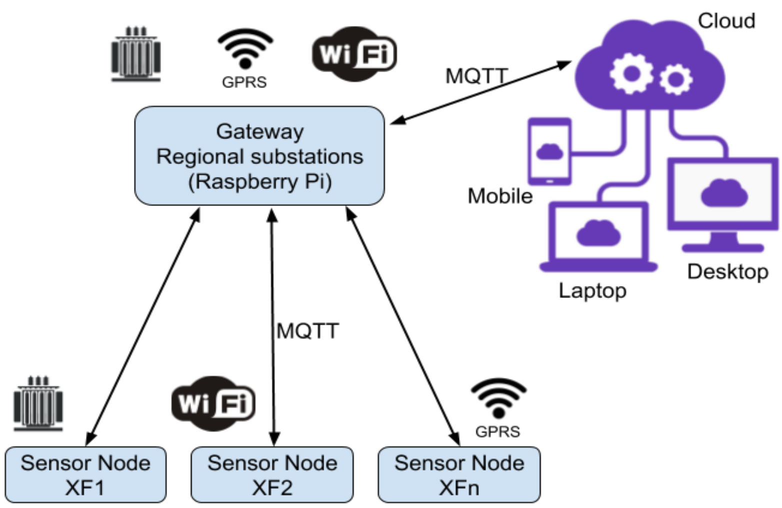

Fig 5. DTMS using MQTT

E. Managing Transformer overload using Smart Relays

Dave Fedirchuk and Curtis Rebizant propose a DTMS which uses smart relays. For a long time , power utilities relied on safety relays (electromagnetic and digital relays of first generation) to perform only one basic, isolated function - fault protection. It has been attributed to many factors but primarily to insufficient computing power, at the time. Since the advent of second-generation digital relays, using efficient digital high-speed signal processors (e.g. DSPs), the protective relay is able to efficiently and easily perform the normal protective functions with processing overhead to spare. This extra processing capacity allows the relay to do more than just offer standard protection. Combined with a Windows-driven relay setting environment, these digital relays provide increased input / output capability, digital fault recording, and functionality of asset management in a powerful yet simplified solution. Such features in asset management enables, for example, safety relays to provide temperature and overload control for transformers. This article discusses the use of a "smart" relay which provides a power transformer with both fault and overload protection.

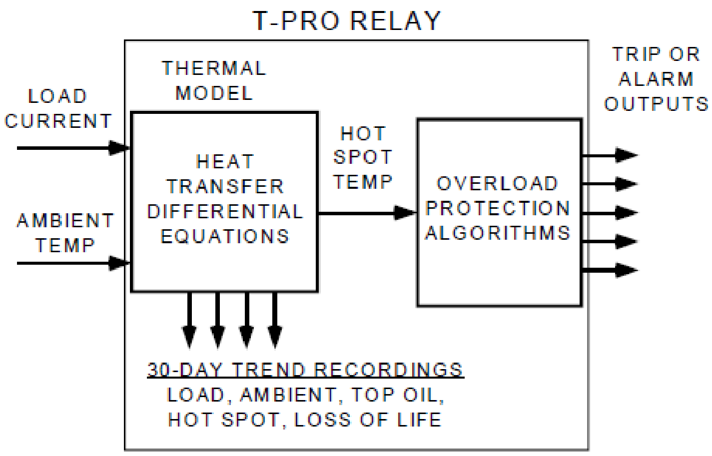

Fig 6. Smart transformer relay model

3. Conclusion

The current monitoring system fails to ensure a healthy life for the transformer. Proper monitoring and maintenance can give distribution transformers a smooth service life. A reliable power distribution system needs to use protective devices that essentially lower the operational expenses. This paper aims to describe already existing methodologies used to implement the online Distribution transformer maintenance system (DTMS). This study would aid in lowering costs by reducing the maintenance workforce. Also, monitoring and control of the loads in real-time can help increase system performance and efficiency.

4. References

[1] Prof. M. S. Sujatha & Dr. M Vijay Kumar, “On-Line Monitoring and Analysis of Faults in Transmission and Distribution Lines Using GSM Technique”, Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, E-ISSN: 1817-3195, 30th November 2011, Vol. 33 No.2.

[2] Priyanka R, Chaithrashree N, Sangeetha S,Bhagyalakshmi, Divyashree A, “Design and Implementation of Real-Time Transformer Health Monitoring System using Raspberry-Pi” International Journal of Engineering Research & Technology (IJERT) , ISSN: 2278-0181 Published by, www.ijert.org NCESC - 2018 Conference Proceedings, Volume 6, Issue 13

[3] Tarun Kanti Roy, Tusher Kanti Roy, “Implementation of IoT: Smart Maintenance for Distribution Transformer using MQTT”

[4] Dave Fedirchuk, Curtis Rebizant “Managing Transformer Overload - Smart Relays” IEEE Canadian Review - Summer/Été 2000

[5] Jaswinder Singh, and S.K. Aggarwal “Distribution Transformer Monitoring for Smart Grid in India” DOI:10.1109/ICPEICES.2016.7853297 Conference: 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES)