

Transformer Health Monitoring by using Sensor

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ABSTRACT: Distribution transformers are one of the most important equipment in power network. Because of, the large number of transformers distributed over a wide area in power electric systems, the data acquisition and condition monitoring is a important issue. The main aim of this system is distribution transformer monitoring and controlling through GSM modem. Here transformers are damaged due to the oil damage. Oil damage is depends on different parameters and environmental conditions. Now in this system we are concentrating on temperature of transformer and viscosity of oil .In this system temperature and viscosity monitoring and control action is performed based on the microcontroller. After interfacing the required components user has to develop one application program in embedded-c. Here controller is continuously reading the temperature, voltage and current and display on the LCD. Distribution companies have a strong competition among them to provide reliable power at a low cost. As per reports, maintenance as well as replacement of transformers is found to be an expensive exercise for all companies. Keeping this factor in mind, IoT based distribution transformer monitoring system is developed in this work to monitor health conditions of distribution transformers on regular intervals. Health index is determined on the basis of change in voltage, temperature variations and load ability, which are measured using sensors. Arduino has been selected as the processor for the sensed data while Thing Speak has been selected as the IoT platform. This low cost system can be installed in transformer at any location to get monitored remotely, which not only determines health condition but also is helpful in predicting its life span as well

KEYWORD: Internet of Thing (IoT), Liquid Crystal Display, Global system for Mobile (GSM)

I. INTRODUCTION

Distribution transformers have a long service life if they are operated under good and rated conditions. However, their life is significantly reduced if they are overloaded, resulting in unexpected failures and loss of supply to a large number of customers thus effecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformers. Most power companies use Supervisory Control and Data Acquisition (SCADA) system for online monitoring of power transformers but extending the SCADA system for online monitoring of distribution transformers is an expensive proposition. Distribution transformers are currently monitored manually where a person periodically visits a transformer site for maintenance and records parameter of importance. This type of monitoring cannot provide information about occasional overloads and overheating of transformer oil and windings. All these factors can significantly reduce transformer life. Our system is designed based upon online monitoring of key Operational parameters of distribution transformers can provide useful Information about the health of transformers which will help the utilities to Optimally use their transformers and keep the asset in operation for a longer Period. This system will help us to identify problems before any catastrophic Failure, thus resulting in a long life service for transformers. This system is based on embedded system as we are using microcontroller as discussed before. Embedded systems are self-contained programs that are embedded within a piece of hardware. embedded systems are usually set to a specific task Another way to think of an embedded system is as a computer system that is created with optimal efficiency, thereby allowing it to complete specific functions as quickly as possible. It is also has the advantages of significant cost savings, power consumption and greater reliability

II. OBJECTIVES

- No Wires Involved In the Proposed System. Hence We Can Avoid Power And Data Loss.
- It Can Able To Detect The Faults Due To Over Current, Over Voltage, Increased Temperature At Real Time.

- Monitoring Multiple Transformers Sitting In An Office Is Possible.
- Perrault Condition Is Easily Detected And Cleared At Same Time To Avoid System Failure. Fault
- Monitoring Requires Less Time Also Use Of Wi-Fi Gives Most Accurate Fast Response.
- This Type Of Monitoring Protects Transformer And Overall System So System Reliability And Stability Increases.
- This Type Of Monitoring Provide Significant Benefits For Utility Consumers As Ideal Power Supply Can Be Possible Which Is Free From Fault And Losses.

III. TRANSFORMER HEALTH MONITORING

Our aim is to develop an IoT based remote monitoring system for multiple distribution transformers of an area, so that life expectancy of distribution transformer can increase with regular maintenance which could help companies to reimburse their capital investment on transformers. Remote monitoring is based on health index calculations of transformers based on parameters like current, voltage and winding temperature. Data syncing is done through a web server called as data hub, and synced data is processed in MATLAB software at a utility substation based all-in one server which calculates health of distribution transformers. Health index can be used to predict life expectancy of transformer and can prevent reactive maintenance. An overview of operation is given as in figure below.

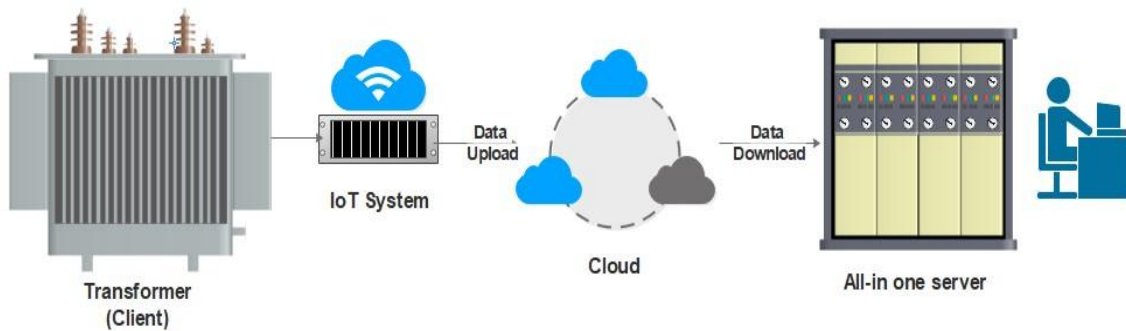


Figure 1. Overview of proposed system

Power distribution companies try to maximize profits by attracting customers and ensure a regular, reliable and high-quality power. Even utilities minimize their maintenance costs. The main component of the distribution company is the transformer, the distribution transformer and the high voltage wires. Reliable substations in distribution companies are numerous and even in urban or rural areas. The distribution or service transformers for these substations are in quantum of number. Substation transformers are equipped with overcurrent protection, ground protection and differential power protection, while service transformers use horn fault protection. As the amount of service transformers is optimal, regular maintenance will be difficult. In this way, most of the time troubleshooting is reactive Maintenance. The current trend is utilizing devices to highest potential and the repayment of all capital investments offered for renovation or installation. Figure 8 shows the general problem of distribution companies.



Figure 2. Distribution System

An IoT based environment consists of different sensors, communication medium and devices *etc.* through which they process information among each other. IoT based devices share sensor data through cloud and processes accordingly which can be analysed and can be used for decision making accordingly [1]. All IoT based devices perform without human intervention, and even people can interact with devices as shown in Figure.

The system given below shows an example of IoT environment, where different IoT based devices are sending data to a hub and here accumulation of data occurs. Accumulated data can be further processed to be analysed or sent to different user interfaces like smart-phones, human machines *etc* and desired actions can be taken.

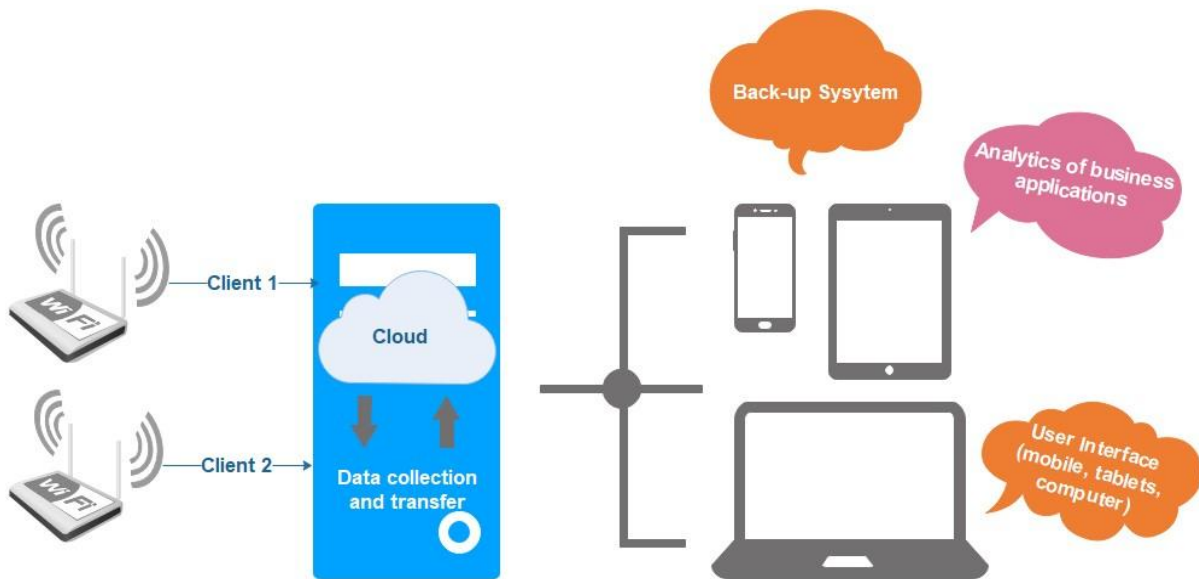


Figure 3. Overall operation of Internet of Things

It is a big technology advancement; where, a human interacts with the machines and perform work more accurately and swiftly. As per studies, billions of the devices will be connected to internet by 2025 [2]. Interconnection of devices will create an intelligent network and will build smart devices. Thus when they are interconnected they can analyze the data in countless ways which creates better and faster products at low costs. All tasks can be performed more accurately and automatically with combination of IoT and automated devices. IoT offers us an opportunity for saving our time, money and utilizing our resources optimally.

Overall system and process monitoring is faster with the introduction of IoT and automation. Not only had this, but Internet of Things also improved customer’s usage experience with a product or service, which provides better value and higher reliability. IoT also saves time and money of companies for the establishment of monitoring systems *e.g.* post-fault clearing time can reduce if such a monitoring system is used in electrical distribution networks. By the implementation of IoT based devices in offices or homes, it has been found that autonomous systems like thermostat, air-conditioners, lightning *etc.* make the overall daily routine faster as human can now spend more time in other tasks. An IoT based system can be operated remotely and is also easy to monitor even in extreme weather and working conditions. Thus, IoT based systems are more reliable, fast, accurate, economical and safe to use.

A power transmission line is one of the important need and features of an IoT based monitoring system. High voltage transmission lines come under many natural disasters which can affect stability and reliability of the system [3]. At present, many wireless network systems have been put into practice, but there are some problems of high maintenance and operation costs.

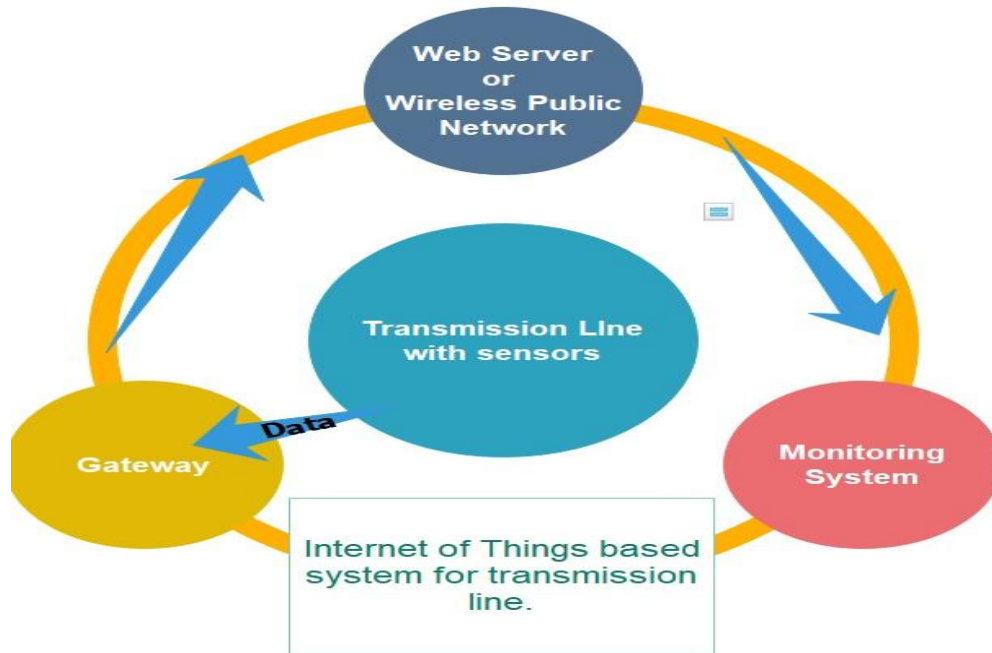


Figure 4. IoT based Transmission Line

IoT monitoring of transmission lines is composed of two parts: one is to monitor the transmission line conductor state while the other is to monitor tower condition state.

Different sensors like temperature, humidity, wind and other meteorological sensor, vibration sensor, ultrasonic sensor, tower leaning sensor, infrared sensor, leakage current sensor and camera build the monitoring system of transmission line and tower

IV. TESTING AND RESULTS

Online parameters of 1 ϕ - transformer are given as shown in figure 22, field chart 1 displays temperature variations, field 2 display voltage variations while field 3 displays current variations.



Figure 5. Variation Parameter Graph



Represents all measured parameters uploaded by client into cloud server, while figure 24 displays health index calculated by all-in one server which is 20%.

Sr.No	Voltage	Current	Temperature
1	56	0.6000	34
2	55	0.6200	35
3	57	0.6100	35.4000
4	56	0.6300	37
5	57	0.6400	36
6	58	0.6500	36.7000
7	56	0.6000	34
8	55	0.6200	35
9	57	0.6100	35.400
10	56	0.6300	37
11	57	0.6400	36
12	58	0.6500	36.700

Table 1. Health index calculated

Health Index Categorization

Health index calculated above is categorized on the basis of limits shown in figure 6. As, health index calculated above, as shown in figure 24 is 20% so as per categorization, our system is at an any time of failure state.

Sr.No	HI%	Health State	Requirement
1	85-100	Good	Normal maintenance
2	65-80	Fair	Increase periodic maintenance
3	50-65	Poor	Replacement required
4	0-50	very poor	Risk of any time failure

Table 2. Health index categorization

V. DISCUSSION

Above, IoT system is an improved and advanced version of GSM technology based system, where, no third party cloud as well as all-in one server was introduced. And, thus has very little or no scope of algorithm updation and also is an expensive technology. While, our introduced system has overruled all these limitations and has also introduced a new scope of time to time algorithm updation feature with no additional cost.

VI. CONCLUSION

The IOT based monitoring of distribution transformer is quite useful as compared to manual monitoring and also it is reliable as it is not possible to monitor always the oil level, ambient temperature rise ,load current manually.

After receiving of message of any abnormality we can take action immediately to prevent any catastrophic failures of distribution transformers. In a distribution network there are many distribution transformers and associating each transformer with such system, we can easily figure out that which 42 transformer is undergoing fault from the message sent to mobile. We need not have to check all transformers and corresponding phase currents and voltages and thus we can recover the system in less time. The time for receiving messages may vary due to the public GSM network traffic but still then it is effective than manual monitoring.

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