

# IOT Based Online Monitoring of Transformer Maintenance System

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## ABSTRACT

This paper screens the state of transformer protection oil and keeps up the transformer in solid condition. Because of absence of legitimate work, the power transformers in power board and the circulation transformers utilized as a part of open and private area are not looked after appropriately. The protecting oil in the transformer may infrequently come into contact with air because of spillage in the oil tanks or in related pipe lines, the oxidation response in the transformer oil happens, which will be additionally quickened because of temperature and nearness of impetuses like iron, copper and broke down metallic mixes in the transformer oil because of maturing. The above condition talked about will change the qualities of transformer protecting oil, which truly influences the execution of transformer and may prompts blast of transformer on the off chance that it isn't observed appropriately. The proposed framework performs sharpness and blaze point test which decides the qualities of oil whether to utilize it further or to purge and educated it to the individual worried through GSM and IoT.

Index terms: Insulation oil, catalyst, explosion, acidity, flash point test, GSM, IoT.

## 1. INTRODUCTION

### 1.1. TRANSFORMER

A transformer is basically a static electromagnetic gadget comprising of at least two windings which interface with a typical attractive field. The primary motivation behind power or dispersion transformer is to exchange electric power starting with one voltage level then onto the next. It deals with the essential of electromagnetic enlistment. The principle segments of the transformer are center, winding, protection (strong or fluid) and tank. The oil utilized as a part of transformer is mineral oil. Which is a protecting oil utilized for cooling purposes in the middle of the windings.

### 1.2. INSULATING MATERIALS

The materials which allow just an insignificant current (request of PA) to stream in stage with the connected voltage. Protecting materials or protects are to a great degree differing in root and properties. They are basically non-metallic, natural or inorganic; uniform or heterogeneous in piece; regular or manufactured. A large number of them are of regular starting point as, paper, fabric, paraffin wax and normal tars. Wide utilize is made of numerous inorganic protecting materials, for example, glass, pottery and mica.

#### *Properties of insulating materials*

Properties, which describe the protecting materials, e.g. resistivity, breakdown voltage, permittivity and dielectric misfortune, and so forth. A perfect protecting material ought to have

1. High dielectric quality managed at lifted temperature.
2. High resistivity.
3. Great warm conductivity.
4. High malleable and shear quality of strong protection.
5. High level of warm strength.

6. Notwithstanding the above properties, the material ought to have other mechanical properties, for example, capacity to withstand dampness (it ought to be non-hygroscopic), vibration, scraped spot and bowing. Additionally, it ought to have the capacity to withstand substance assault, warm and other antagonistic states of administration.

### ***1.3. TRANSFORMER OIL***

Oil utilized for protection in transformers is mineral oil and it is acquired by refining unrefined oil. Creature oils and vegetable oils are not utilized for this reason as these shape unsaturated fats on warming which are destructive for the cellulosic paper utilized as a part of protection. Mineral oils were being used as fluid dielectrics in electrical hardware for more than hundred years now. In spite of the accessibility of an assortment of manufactured oils, with significantly more prevalent properties, mineral oils held its way, because of their plenteous accessibility and economy. The properties that are central to utilization of mineral oil as dielectric seem to be:

1. High protecting property.
2. Good oxidative and maturing solidness and great warmth transferability.
3. High electric quality to withstand the worries in benefit.
4. Sufficiently low consistency.
5. Proper oxidation protection from guarantee long life in benefit.
6. Good protection from emulsion to avoid holding water in suspension in it.
7. Free from sludging under ordinary isolating conditions.
8. High flash/fire points.
9. Low pour, water point.

### ***1.4. CONDITION MONITORING OF TRANSFORMERS***

Impressive measures of cash have been put resources into the introduced control hardware in the electrical vitality frameworks. Power transformers are an essential piece of it. They speak to a profitable resource for the utilities, and are relied upon to be utilitarian more than many years. In prior days it could happen that power transformers with long operational years and impressive feeble or a potential wellspring of inconvenience were essentially supplanted. Cash was no issue and the last vitality client needed to pay the bill at last. Today the worldview has changed and significant endeavors are coordinated into finding new methodologies utilizing transformer checking, conclusion and life evaluation.

### ***1.5. IoT TECHNOLOGY***

Internet of Things is characterized as Things having characters and virtual identities working in keen spaces utilizing canny interfaces to associate and impart inside social, ecological, and client settings. It can be viewed as the Future of Internet, where each question is associated with different articles. Each protest is given an extraordinary personality in the system.

Permits remote access of gadgets through the system, whenever and at any area. IoT empowered articles speak with each other, get to data over the Internet, and associate with clients making brilliant, unavoidable and constantly associated situations. IoT additionally empowers machine to machine correspondence which permits machines being controlled by the Internet and by different machines. This can change the way innovation is utilized, as machine takes control of machines conquering the requirements that individuals confront while speaking with advanced frameworks. Machines can screen sensors everywhere throughout the world to produce tremendous amount of important data that would take human years to accomplish.

## 2. PROPOSED SYSTEM

### 2.1. ACIDITY TEST

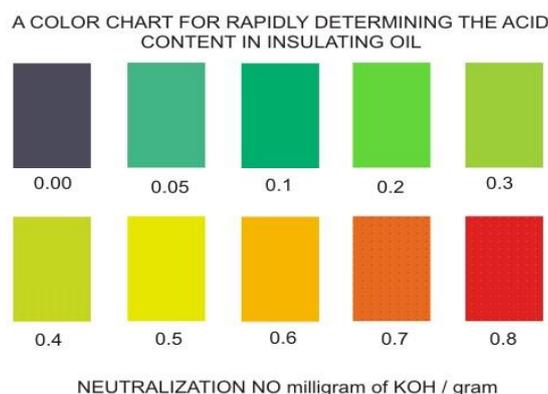
The causticity of protecting oil is for the most part estimated by the required amount in milligram of KOH to totally kill the corrosiveness of a particular amount in gram of the oil. Acridity of a protecting oil is 0.3 mg KOH/g implies 0.3 milligram of KOH is required to kill 1 gram of that protecting oil.

#### 2.1.1 Procedure

For that we have first to take precisely 1 gram of protecting oil. We ordinarily do this by taking 1.1 milliliter of the oil to be tried by given volumetric syringe. In reality, 1.1 milliliter oil is taken as 1 gram of oil. Before test we need to extricate the broke down corrosive in the oil. That we do by including precisely 1 ml of redressed soul (ethyl liquor) in the test. This is on account of the corrosive created in the mineral oil is profoundly dissolvable in the liquor. In the wake of shaking the test well we include 1 ml of sodium carbonate in the sample. Sodium carbonate is the most appropriate antacid for that reason since it doesn't change its qualities much when interacts with environment amid utilize. Finally after re-shaking the sample blend we need to include 5 drops of all inclusive pointer in the sample.

#### 2.1.2. Observation

The shade of the sample oil in the wake of blending corrected soul, sodium carbonate and general marker, portrays the estimation of corrosiveness of the oil test in mg KOH/g as takes after.





0.25-0.3

Figure 1 A color chat for acid content in transformer oil

The stream graph appeared in figure 1 demonstrates the sharpness substance of transformer protecting oil. By utilizing shading sensor TCS230 we can naturally identify the corrosiveness substance of transformer oil which is the milligram of potassium hydroxide display per gram of oil. In the event that the sharpness substance of oil is inside 0.3 mg KOH/gram the oil is in great condition. Table 1 Shows shading graph for acidity. In the event that it surpasses 0.3mg of KOH/gram we have to clean the oil. i.e., the oil is in terrible condition.

Color	Acidity value
Dark blue	0.00
Dark green	0.05
Green	0.1
Light green	0.2
Pale Violet	0.25-0.3
Pale green	0.3
Pale yellow	0.4
Yellow	0.5
Pale orange	0.6
Orange	0.7
Red	0.8

Table 1 color chart

## 2.2. FLASH POINT TEST

Streak purpose of an unstable fluid is the least temperature at which it can vaporize to frame an ignitable blend in air. The blaze point test decides the solidness.

### 2.2.1. Procedure

The proposed framework in which acceptance stove is utilized to warm the transformer protecting oil. The temperature is estimated by utilizing thermocouple k write. The greatest temperature estimated by thermocouple k compose is – 328 to 2282°F.

Hydrogen gas sensor is utilized to decide the gas advanced which frames a combustible blend with air. The temperature of least 1200 C to greatest of 1800 C at which the oil deliver the combustible blend with air hydrogen gas recommends that the oil is in great condition.

### 2.2.2. Observation

In the event that the oil create combustible apparatus with air particularly hydrogen gas up to 500ppm inside 140-1600 deg C the oil is in great condition. The temperature over 1800 deg C at which the transformer protecting oil advances the combustible blend with air proposes that the oil is in terrible condition and we have to sanitize the transformer oil.

### 2.3. THINGSPEAK

The Internet of Things (IoT) is an arrangement of associated things. The things by and large contain an inserted working framework and a capacity to speak with the web or with the neighboring things. One of the key components of a nonexclusive IoT framework that scaffolds the different things is an IoT benefit. An intriguing ramifications from the things containing the IoT frameworks is that the things without anyone else's input can't do anything. At an absolute minimum, they ought to have a capacity to associate with different things. Be that as it may, the genuine energy of IoT is tackled when the things interface with an administration specifically or by means of different things. In such frameworks, the administration assumes the part of an undetectable chief by giving abilities extending from basic information gathering and checking to complex information examination. The underneath outline delineates where an IoT benefit fits in an IoT biological system in figure 2.

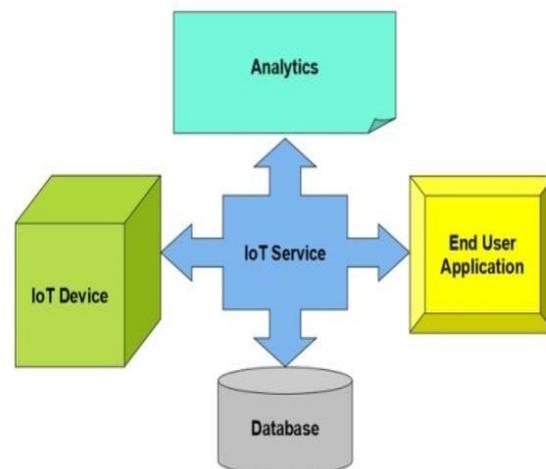


Figure 2. IoT service in IoT ecosystem

Thing Speak is a stage giving different administrations only focused to building IoT applications. It offers the capacities of ongoing information gathering, picturing the gathered information as graphs, capacity to make modules and applications for working together with web administrations, interpersonal organization and different APIs.

### 2.4. CLOUD SERVICE

The collected user's data is communicated to a cloud server which is responsible for facilitating the accessibility of such a data anywhere through the Internet. The cloud server implements a wide set of data management services

including data storage, data analytics, and data visualization in addition to providing an appropriate application program interface (API) and software tools server shown in figure 3. The cloud server core is a large database that has enough space to accommodate the huge amounts of data for the different sensors for long times to track the history of the system user. The database is interfaced to a wide set of data analysis algorithms and APIs such as Google Sheets for data visualization. Data can be accessed through the Internet using dynamic webpages.

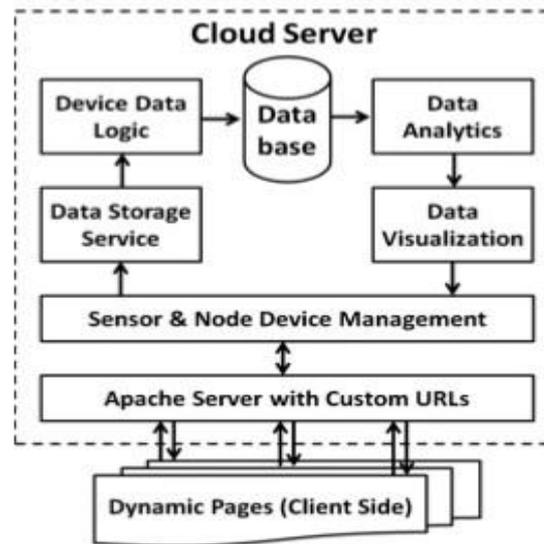


Figure 3. cloud computing

### 3. HARDWARE DESCRIPTION

#### 3.1. ARDUINO UNO BOARD

Arduino is an open-source devices arrange in perspective of easy to-use gear and programming. You can control your board by sending a course of action of headings to the microcontroller on the board. To do in that capacity you use the Arduino programming tongue (in perspective of Wiring), and the Arduino Software (IDE), in light of Processing.

#### 3.2. COLOR SENSOR TSC230

The Color Sensor is a total shading indicator, including a TCS230 RGB sensor chip and 4 white LEDs. The TCS230 can recognize and measure an almost boundless scope of noticeable hues.

#### 3.3 THERMOCOUPLE TEMPERATURE SENSOR

A thermocouple is a gadget utilized widely to measure temperature. A thermocouple is contained no less than two metals consolidated to frame two intersections. One is associated with the body whose temperature is to be estimated; this is the hot or estimating intersection. The other intersection is associated with an assemblage of known temperature; this is the cool or reference intersection. In this way the thermocouple measures unknown temperature with reference to the known temperature of an insulating oil.

### 3.4. HYDROGEN GAS SENSOR

The Hydrogen sensor (MQ 8) is equipped for recognizing Hydrogen gas in air. It can be introduced in businesses where hydrogen is utilized generally. Its scope of detecting differs from 100 to 10000 ppm of Hydrogen gas in air. This sensor has particular computerized or simple yield ability which can be estimated effectively with Arduino or some other small scale controller.

### 3.5. GSM

Overall system for adaptable correspondence (GSM) is an exhaustively recognized standard for automated cell correspondence. GSM is the name of a systematization accumulate set up in 1982 to influence a normal European cell to telephone standard that would characterize points of interest for a holder European flexible cell radio structure working at 900 MHz. It is assessed that various countries outside of Europe will join the GSM affiliation.

## 4. SOFTWARE DESCRIPTION

### 4.1. ARDUINO IDE

The open-source Arduino Software (IDE) makes it easy to form code and exchange it to the board. It continues running on Windows, Mac OS X, and Linux. Nature is made in Java and in light of Processing and other open-source programming. This item can be used with any Arduino board.

## 5. RESULT ANALYSIS

The acidity and flash point test helps us to determine the characteristics of Transformer insulating oil. If the acidity value is within 0.3 and the transformer insulating oil forms flammable mixture with air within temperature limit of 140-160 degree Celsius the oil is in good condition otherwise we need to purify the oil. Condition of transformer oil by tests is shown in table 2.

S.No	Total number of conditions to be satisfied	Results to be exhibited
1	2	"The Transformer oil is in Good condition"
2	1	"The Transformer Oil has to be monitored"
3	< 1	"The Transformer oil is not in Good condition"

Table 2. Conditions for analysis of transformer oil efficiency

## 6. CONCLUSION

The proposed system performs acidity and flash point test to determine the characteristics of transformer insulating oil and to predict whether to change, purify the oil or to continue with the same oil. The proposed system helps to maintain the transformer in the healthy condition.

## 7. FUTURE ENHANCEMENT

The proposed system performs only two tests and it is semi-automated. In the future system one more test is going to be conducted and it is made to be automated.

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