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Survey on Application of SVM and KNN to Duval Pentagon 1 for Transformer Oil Diagnosis

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Abstract— **Dissolved Gas Analysis (DGA) is a widely used technique to estimate the condition of oil-immersed transformers. The experimental results of the level and the change in concentration of different combustible gases in the insulating oil is a trustworthy diagnostic tool which can be used as indicator of undesirable events occurring inside the transformer, such as hot spots, electrical arcing or partial discharge. The objective of this paper is mainly to analyse available data from DGA, and investigate data that may be useful in quantitative modelling of the transformer as reliability. Depending upon the location of a transformer, its rating and the nature of its usage, some dissolved gas analysis is to be scheduled which will be appropriate for that transformer. The more critical the unit is the more frequently it should be sampled. Here they have used the Support Vector Machine (SVM) and the K-Nearest Neighbour (KNN) algorithms for the diagnosis of oil transformer. From these two algorithms from method known as a dual pentagon 1 diagnosis for this they adopted five classes namely PD, D1, D2, T1 & T2, and T3**

Keywords: *Dissolved Gas analysis, Support Vector Machine, K-Nearest Neighbour, Dual pentagon 1*

I INTRODUCTION

Power transformers are the important elements inside the electric network. Because of the high priced cost of this equipment, it's important to take periodic inspections and preservation to make certain an efficient service. Lifetime of power transformer is related to the presence and absence of fault. There are several methods for detecting faults in transformers related to dielectric insulation. The quickest and economical one is the dissolved gas analysis (DGA). This is used for monitoring faults. Such analysis approach is considered as one of the most dependable predictive methods used to lessen faults risks. Additionally, DGA comes with the benefit that evaluation will be carried out in the course of transformer service.

In the fault conditions the insulating oil decomposes causing formation of the fundamental dissolved gases, namely hydrogen (H2), methane (CH4), acetylene (C2H2), ethylene (C2H4), and ethane (C2H6). Further, the decomposition of the insulating paper produces carbon monoxide (CO) and carbon dioxide (CO2) gases. Several types of fault conditions are determined after analyzing the gases. So here to find six basic thermal and electrical fault are used by IEC and IEEE consist of low energy discharges, partial discharge, thermal faults, high energy discharge.

In transformer oil to clarify the DGA results, several types of methods are developed. In which the conventional method is limited to use. That uses four gas ratios. These traditional DGA techniques are easy to apply, but their diagnosis accuracies need development. A Duval Pentagon primarily based on the 5 predominant hydrocarbon gases. This approach uses five relative percentages i.e. (%CH4, %C2H4, %H2, %C2H6, %C2H2). Except to the faults considered by way of IEC and IEEE, a further one associated with stray gassing (S) has been introduced.

Various techniques applied in transformer fault diagnosis. From gas ratio values input vector is formed in all techniques. Bayesian discovers type of faults and decrease the risk of failure. This is based on IEEE/IEC DGA ratio method. Based on these, the proposed method will be considered as supportive tool, that it is able to tackling the DGA troubles. Generic programming and bootstrap presented to overcome the faulty class samples and accuracy and fault classification for the power transformer DGA

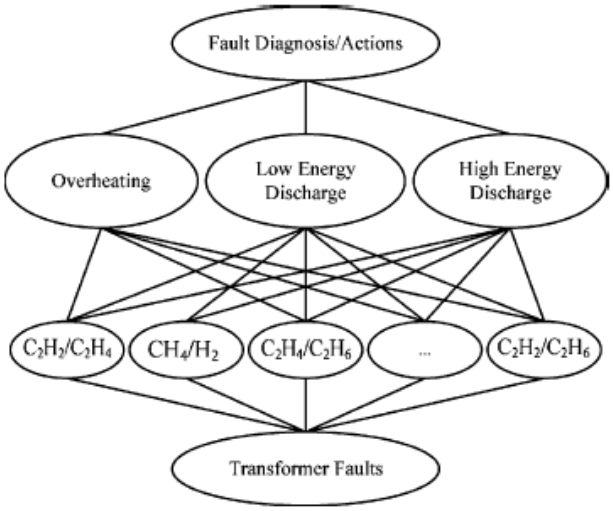

Figure 1: Diagram of DGA fault diagnosis

In which the genetic programming extracts the feature for class. These features are used for artificial neural network, K-nearest neighbor, and support vector machine as input.

Graphical techniques developed for detection of fault transformers. Two proposed graphical methods use 4-gas relative percentages for classifying the six thermal and electrical faults considered by IEC and IEEE. Graphical technique just like Duval Pentagon has been offered. It is based on the main five flammable gases. It uses the same primary electric and thermal faults taken into consideration via IEC and IEEE. The novelty investigates the use of machine learning algorithm to

complement Duval Pentagon 1 interpretation. In which they have to combine SVM and KNN algorithms with dual pentagon 1. IEC and IEEE inspired for fault consideration. Five different classes have been adopted from this i.e. PD, D1, D2, T1&T2, and T3.

II RELATED WORK

Y. Benmahamed, M. Tiger and A. Boubakeur [1], the author discussed Duval Pentagon 1 graphical method for the diagnosis of transformer oil. A Duval Pentagon primarily based on the 5 predominant hydrocarbon gases. Michel Duval [2], the author discussed about the dissolved gas analysis. DGA is the powerful tool; it used to access the condition of the transformer. Several questions remain today, concern about the use of DGA. Failure of transformer based on dissolved gas analysis. It depends on three main parameters.

A. Abu-side, S. Islam Norazhar and Abu Bakar [3], for transformer fault diagnosis, author presents a Parzen Windows based classifier. This classification then converted into a PW method for fault classification. The proposed method provides DGA reviewers with confidence to support decision making. The result shows that the computational efficiency and diagnosis accuracy improve and that is compared with the different type of fault classification techniques.

N. Abu Bakar, A. Abu-Saida and S. Islam [4], to access the power transformer conditions, dissolved gas analysis is used. It uses the various types of gases dissolved in the transformer oil because of the decomposition of oil. Dissolved gas analysis is used worldwide for the detection of fault in transformers. There are several types of faults such as partial discharge, overheating. Concentration is used for identifying faults and design method to solve faults. Gas chromatography is used for analyzing the gases dissolved in the oil. This is used in the UK Central Electricity Generating Board. Today CG is accepted as a best DGA technique for measuring the concentrations in transformer oil.

M. Duval [5], the behavior of the transformer is monitored by using dissolved gas analysis. In which two techniques are described and two oil detectors are described. Hydrogen concentration to be measured easily using this technique. Remote monitoring is possible from substation using second model. Fault detection using DGA is examined and gas level is indicated. On the basis of DGA expert systems are analyzed.

M. Hasmat [6], using gene expression programming, the author designed a new approach for DGA interpretation. It's used to analyze samples collected from transformers of Himachal Pradesh State Electricity Board. To test GEP model use various data sets. It compares with the other artificial intelligence-based techniques such as fuzzy-logic, artificial neural network, support vector machine. Comparisons and results show that the GEP model more accurate.

X. Hao and S. CAI-Xian [7], Dissolved gas analysis is used to detect the fault in transformers. The capability of dissolved gas analysis an artificial immune network classification algorithm used. It describes the complex interaction of antibodies. Algorithm used for defense against the faults of power transformers. It finds all fault samples and features, which is used to realize dynamic classification. The proposed algorithm is tested with various fault samples, which is show that the proposed has accurate and it can be classify fault easily.

W. H. Tang, Z. Lu and Q. H.Wu [8], for dissolved gas analysis problem author describe the Bayesian network approach. In this the author first introduces the graphical presentation of uncertain knowledge. Diagnose transformer faults based upon the IEEE/IEC DGA ratio method designed by Bayesian network. A relevant strategy to a transformer DGA hassle, the usage of the Bayesian network method, is illustrated highlighting the capability of Bayesian networks. The result shows that the proposed system capable of tackling the DGA problem W. Chen, C. Pan, Y. Yuan and Y. Liu [9], the author discussed about the Wavelet networks and faults of power transformers. In this author compare network training process and results of Wavelet networks. That includes two activation function and two types of Wavelet networks. Several diagnostic examples show that the proposed approach is more suitable for fault diagnosis of power transformers.

S. Lee, Y. Kim, H. Seo, J. Jung, H. Yang, and M. Duval [10], Author proposed two diagnosis method and four gases are generated in the transformer. In this paper author selected these gases as diagnose faults. Proposed system accuracy is check using databases and IEC TC 10.

D. A. Mansour [11], the author proposed a graphical technique for the DGA. The developed technique is a form of pentagon shape. This shows that the percentage concentration of each individual gas. Faulty case determined by the center of mass of all pentagon heads. Using the previous DGA methods, knowledge Find the fault area within the pentagon. In this boundary are indicated using DGA data. Using a set of fault cases proposed system performance is calculated.

Table I: Survey Table

Sr. No	Paper Name	Author Name	Technique Used	Advantages
1	New frontiers of DGA interpretation for power transformers and their accessories	Michel Duval	Dissolved gas analysis	-To solve many questions related to use of DGA. -Online gas monitor detects the faults occurring in oil sampling intervals.

2	A probabilistic Classifier for Transformer Dissolved Gas Analysis With a Particle Swarm Optimizer	W.H. Tang, J. Y. Goulermas, Q.H. Wu, Z. J. Richardson, and J. Fitch	Parzen Windows based classifier	-The computational efficiency and diagnosis accuracy improve. -Severity code to indicate the condition levels of a transformer.
3	A Review of Dissolved Gas Analysis Measurement and Interpretation Techniques	N. Abu Bakar A. Abu-Saida and S. Islam	Vacuum extraction method	-Measuring the concentrations in transformer oil. -Can detect incipient faults
4	Dissolved Gas Analysis: It Can Save Your Transformer	M. Duval	Hydrogen-in-oil detectors	-Fault detection using DGA is examined and gas level is indicated. -Monitoring transform-ers in service
5	Application of Gene Expression Programming (GEP) in Power Transformers Fault Diagnosis Using DGA	M. Hasmat	Gene expression programming	-Analyze samples collected from transformers -Diagnose incipient transformer faults

III PROPOSED SYSTEM

A. Proposed work:

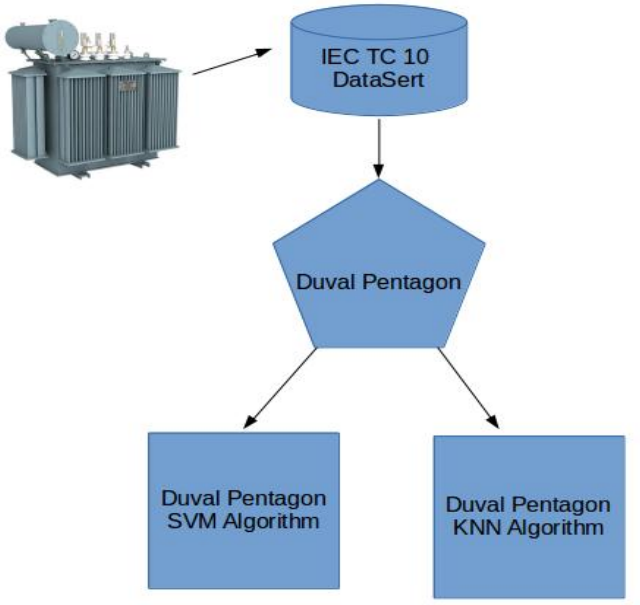

Figure 1: System Architecture

- IEC TC 10 Datasets: We take five gases as a dataset.
- Dual Pentagon: Dual pentagon is a graphical technique used for transformers fault detection. Dual pentagon is based on five gases. Then SVM and KNN algorithm combined into the dual pentagon 1. Dual pentagon gives the percentage of acid gases. Several methods are available for DGA results.
- Support Vector Machine (SVM): Support vector machine analyzes the data used for classification. SVM is solving the classification problems, by finding the higher margin. SVM also performs the linear and nonlinear classification. It's used for text and hypertext categorization. SVM archive higher search accuracy and hand written text also identified by SVM.
- K-nearest neighbor Algorithm (KNN): KNN is non-parametric method used for classification and regression. It is a machine learning algorithm. Classification and regression is used to assign weights to the contributions of the neighbors. Generally, neighbors are taken from a set of objects.

IV CONCLUSION

Two machine techniques known as SVM and KNN are used to implement Dual pentagon 1 for the transforming insulating oil fault classification for this they used a dissolved gas analysis (DGA) data. The resulting analysis of this paper shows that the SVM performance is much better than a KNN. These techniques are more powerful for power transformers insulating oil diagnosis.

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