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AN EFFICIENT FAULT DIAGNOSTIC SYSTEM FOR TRANSFORMERS USING KNN IMPUTED DATASET

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Abstract— **Fault diagnosis of power transformers have been widely needed to prevent the serious damages. It is emphasis to detect the possibly accommodate faults in earlier stages. This system calculates attention and warning value of transformer with different intrinsic properties by data mining techniques. This proposed work focused to predict the missing values from real-time dataset and replaces with corresponding feature values using the k-nearest neighbour algorithm. KNN imputed datasets are inputted for Apriori and SPA (Set Pair Analysis) Algorithms, to determine efficient fault transformer diagnosis. This paper proposed a data mining model which can predict the occurrence of uncertain faults and determines associated problems efficiently during transformer whole running state.**

Keywords— **Apriori, SPA, Association Rule, KNN, Imputed dataset.**

I. INTRODUCTION

Power transformers are decisive parts of electric transmission system[1]. So, the fault diagnosis has been concerned seriously. Different fault diagnosis algorithms are used to find the fault in power transformers. Support Vector Machine[2], artificial neural network method, Bayesian method and extension theory method algorithms achieved good result in fault diagnosis. Recent development of research based on diagnostics aging transformer using essential characteristics. The experiment results will give proper decision for assist engineers and managers to replace older transformers and avoid major electricity interruption problems [1]. Usually power transformers may work well with monitors, but little inceptive degradation problems are occurred internal systems[3]. Most of the faults occurred due to this basic degradation problems. Therefore, faults are determined and avoid as early as possible using proper predictive maintenance Model. Few status characteristics are affected due to internal faults caused in a transformer. Often to analyze the potential faults of power transformers and running states, it must be determined to know the change state of transformers appropriately. Normally, real dataset has missing values that cannot give proper accuracy. The existing methodologies the missing values [4] are often deleted; it leads loss of huge data in dataset. The missing values are substituted with proper state parameter values using KNN technique to make efficient dataset.

II. PROPOSED METHODOLOGY

To enhance the reliability of power transformers, a new fault identification method is proposed based on KNN, Apriori and SPA algorithm. The proposed methodology is to identify the imputed dataset and find the fault at early stage to protect from damages.This technique can produce high accuracy in identifying the fault symptoms and fault type.

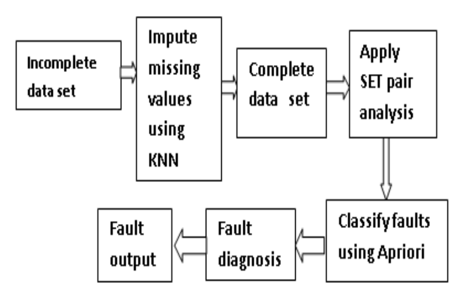

Fig. 1 Fault Diagnosis of power transformer using KNN

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A. *KNN algorithm (IMPUTED METHOD)*

K nearest neighbor classifier algorithm[5], which stores all training tuples and classifies new tuples based on a distance metric (e.g.,Euclidean distance functions).

$$d(x_i, x_j) \equiv \sqrt{\sum_{r=1}^{n} (a_r(x_i) - a_r(x_j))^2}$$

It is mainly used in a transformer fault database in which the data items are grouped into different similar classes to classify the new similarity metric data point. It predicts to determine the tuples with missing values and redundant values in accurately. Classes that are redundant that must be discarded for improved performance. The KNN algorithm is used to fills missing values from stored observation tuples in same data set.This method searches the K nearest neighbor of the case with missing values and replaces by the mean or mode value if the value of a given fault symptoms value is missing in tuple t1,we assume previous stored values appeared in the dataset to be normalized. it can easily deal with multiple missing values which mainly used to produce complete dataset for efficient diagnosis new faults.

B. *SAP and ASSOCIATION RULE*

The main task of set Pair Analysis (SPA) is to solve the relative uncertainty characteristics to represent in a mathematical expression [3].SPA is to connect the fault symptoms with given fault dataset. it generates fault symptoms dataset accurately. To improve attributes selection for determine multiple faults of derived fault symptoms.

Association rule is used to determine the correlation relationships between associated data items [4]. If a fault types are frequent, then associated all of its subtypes should also be frequent. To determine the frequent fault types with correlated fault symptoms with following steps.

Consider the transformer database (TDB) is denoted as *T.* It has a set of transactions where each transaction R is a nonempty itemset such that R in T is represented as T' .Let X be a set of fault symptoms.A transaction R is said to contain X, if X is subset of R. An association rule is an implication of the form X=>Y,where X Belongs to T ,X belongs to T,if X,Y is an empty set than it denote X ∩ Y is an empty.The rule X=>Y holds in the transaction set T with support s,where s is the percentage of transactions in T that contain XUY. This is taken to be the probability,P(XUY).The rule X=>Y has confidence c in the transaction set T,where c is the percentage of transactions in T containing X that also contain Y. This is taken to be the conditional probability, P(Y|X).That is,

Support(X=>Y)= P(XUY) =>(1)

Confidence(X=>Y)= P((Y|X) =>(2)

Rules that satisfy both a minimum support threshold (min_sup)and a minimum confidence threshold(min_con) are called **strong**.min_sup and min_con values are occur between 0% and 100%. Usually, transformer has several fault types. It is very tedious one for classify different type of faults using existing techniques. This paper mainly select some state of information represented several fault types of transformer. This state information is referred as fault symptoms.

In the processing model, many fault symptoms are often occurred in power transformer to specified corresponding fault types. Similarly, symptoms of fault accompanied with several types of fault.So, the main goal of this system has to find the proper relationship between fault symptoms with fault type based on complete data set. The association rule between fault symptom and fault type is denoted as FSi=>FTj. To obtain the *ij*-th fault type *FTj* is denoted as Dj and the sum of fault value of *FTj* is denoted as Dj'.,The occurance of each fault symptoms FSi is O(FSi).Then,Dj' faults with number of occurance of FSi is represented as O(FSiUFTj). The support of FSiUFTj are calculated based on equation(1). The association rule are formed correctly when the FSiUFTj has support value larger than 75%. Here,FSi is a frequent item set,it give close relationship between FSi and FTj . Then,infrequent data items are removed. Only the frequent data items are choosen based on confidence value given in equation (2) finally, the each fault symptoms are related properly with its fault types accurately.

Fig. 1 The symptoms of current status of transformer

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Fig. 3 Select the area for Diagnosis of fault transformer

Fig. 4 Selected area reading of transformer

Fig. 5 Find the missing values usin KNN dataset

Fig. 6 Relationship between fault symptoms with fault type using SPA and Apriori techniques

Fig. 7 Performance of each fault types with its associated fault symptoms

The experimental outcome shows that adequate transformer dataset are analysed correctly. Suppose the given dataset are incomplete than it should corrected using KNN algorithm. According to support value of association rule used to find the association between fault symptoms and fault types. Then, using confidence value the weighted values of fault symptoms are calculated. And, SPA method is used to calculate the correlation degree value of several fault types with its determined fault symptoms. At last, output shows that transformer is in a normal working state or abnormal state. The result shows that proposed techniques are good for fault diagnosis system.

III. CONCLUSIONS

This proposed work correcting the missing values occurred in a dataset. KNN method is applied before SPA and Apriori algorithms, for isolate and identifies classifier to detect fault transformer. Association rules determined the feasible and efficient frequent fault types and fault symptoms of power transformers based on support and confidence value and Apriori for efficient and scalable technique for mining the complete set of frequent patterns. SPA model used to compute

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similarity between fault types and fault symptoms of evaluated data set with tested dataset. The experimental results using the SPA and apriori model were better analysed the dataset than the existing techniques. And, it shows that good classification of several fault types of power transformer efficiently.

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