"Induction Motor Air Gap Analysis in Using Machine Learning"

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Abstract: This paper presents yeah the eccentricity Fault in the induction motor. the decision tree and Power spectrum Analysis methods are used to analyze the spectrum. Induction motor is very much like in the industry. It is also used a lot due to its easy control quality. All three-phase induction motors have mismatch eccentricity. Due to this eccentricity problem we got speed pulsation, vibration acoustic noise, and friction problem between stator and rotor. The proposed methodology is useful on Real-time data and achieves 90% true Value. The installation of various Sensors in order to maintain the Good condition of the induction motor is very costly. In the small industry, I would like to avoid this cost. The Status current contains unique fault spectrum components find fault with using a decision tree algorithm . We can easily analyze the air gap eccentricity faults.

Keywords: Induction Motor, Spectrum Analysis, Decision Tree Algorithm, Air Gap Eccentricity, Pattern Recognition

I. INTRODUCTION

The induction motor and its main Defect- The induction motor is working as the backbone of every type of production area as well as the maintenance area. The induction motor has two main parts first one is the stator and the other is the rotor. Status fault, rotor fault, bearing fault and non uniform air gap are most common fault in electrical rotating machine like induction motor. Various pattern recognition methodology may be applied to induction motor fault finding the system.[1] Different types of faults that is occurs in an induction motor are shown in this chart: This type of electrical motor is robust, easy maintenance reasonable sized. But if any case machine gets faulty condition, the industry will be suffering from big financial losses hence in losses of revenue. In this paper vibration monitoring system applied to bearing fault analysis and experimental result shows that vibration and current is spectra of and rotating machine like induction motor for different bearing faults [2]
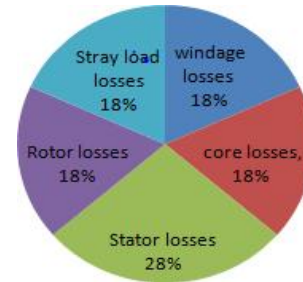

Fig 1: The percentages of common faults in three phase induction motor

II. REVIEW OF MOTORS FAULT DETECTION AND DIAGNOSTICS METHOD.

Defining targets: The initial move towards addressing any AI issue is to characterize the objectives. The issue may be to track down mathematical yield esteem (straight relapse), to isolate into classes (arrangement) or grouping. The sort of AI approach that should be utilized is chosen by concentrating on the issue and removing the goals out of it.

2. Data procurement: The information needed to prepare the neural organization is acquired progressively. The sort and measure of information required relies upon the application.

3. Separating train and test information: The gathered information is then isolated into train and test information to prepare the neural organization model and afterward test its working and compute its exactness [12].

4. Analyzing the discoveries: The acquired outcomes are then examined to check for any mistakes and furthermore to recognize scope for development, assuming any.

5. Interfacing with the genuine framework: Once the legitimate working of the prepared model is affirmed, it is interfaced with a genuine framework and is then utilized progressively Applications.

A. Air Gap analysis for electrical machine

The frequency equation for determining air-gap characteristics

The equation to analysis the air-gap of AC rotating machine

$$P_{eag} = \{(KN \pm \varepsilon)(1-s)\frac{1-s}{s} \pm H\}f$$

P_{eag} = Current Spectrum due to air gap and slotting in rotor
K= Any integer
N=Rotor slots
ε =Eccentricity due to air gap between stator and rotor
=0 for static
=1,2..................n for Dynamic

Air gap Eccentricity Analysis in Induction Motor using Decision tree Algorithm
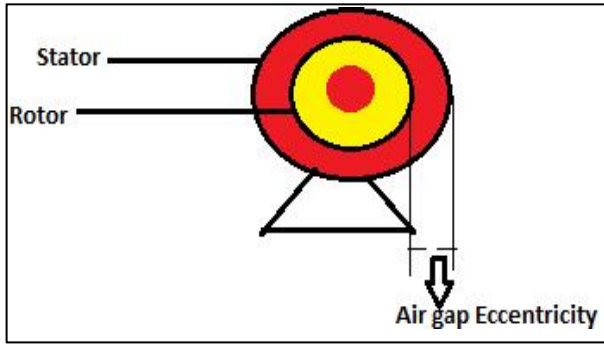

Fig:2 Air gap in Induction Motor

S=slip

P= No.of pole

H_n=Harmonics in stator Current

f_s=Supply frequency

III.   DATASET DESCRIPTION

In problem of supply voltage in balance we get negative currently Sans which shows as stator faults indicator. temperature affect the negative current sequence. this techniques is most powerful technique for status current short circuit problem [3].Data Set of induction motor, All three-phase induction Motor has a genuine air gap between rotor and stator for Desirable output. But sometimes motor can get ore vibration and noise problem. These problem may be due to air gap stator and rotor. We can identify three kind of air gap eccentricity like Dynamic, static and mixed Air gap eccentricity. Now a days power Analyzer used in Industry for Monitoring , Controlling and fortification will systematically capturing skills in the form of value and spectrum and malfunction parts conditions mounted at induction motor .For plan a model for fault classifier, Sufficient volume of spectrum set the fault pattern should be obtainable. Huge spectrum set produce more probability.
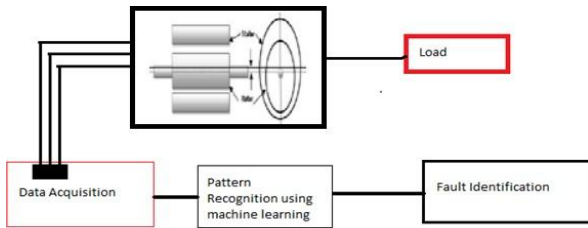

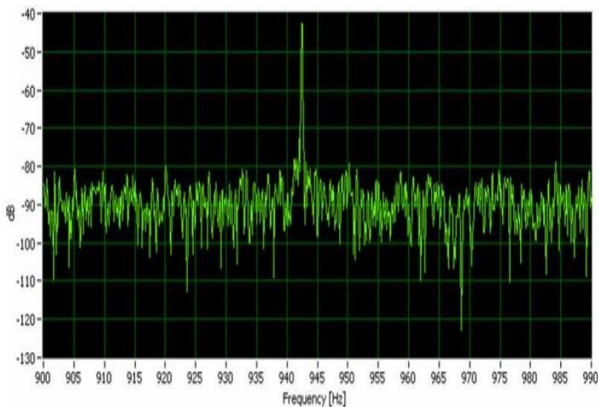**Fig 3: Block Diagram for Pattern Recognition system using Machine Learning**

Fig 4: Power Spectrum of Healthy Motors

The experiments have been performed on 1/3 HP, Induction motors using virtual Instruments like LabVIEW, machine learning algorithms. motor tested on 25% eccentricity, 50% eccentricity, and more. The data set contains measurements of the motors in different cases. Consider a spectrum diagnosis in which we have taken using power Analyzer of a machine and we wish to find out whether our hardware motor has fault or not. In this case the input x is the set frequency(HZ) in the image, and y is the set of DB. If pattern is not same as given pattern then output indicates type of fault with % of static eccentricity.
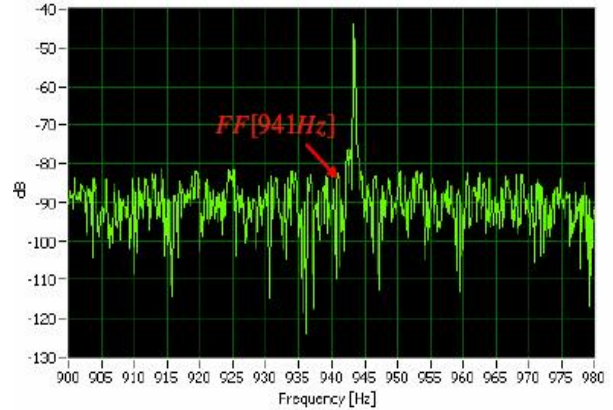

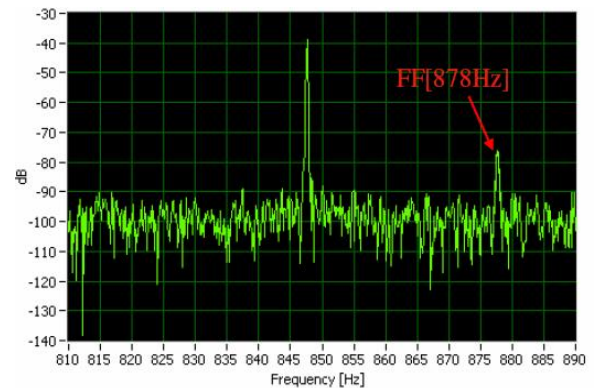**Fig 5: Power Spectrum 20 To 25% Of Air Gap Eccentricity**

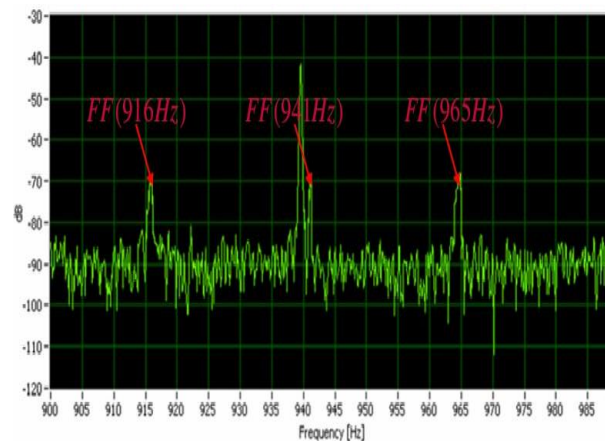**Fig 6: Power spectrum 50 to 60% of Air Gap eccentricity**

Fig 7: Power spectrum for mixed eccentricity

Table 1: For Air Gap eccentricity

S.no	The frequency at different condition	Magnitude	Remark
1	-916 HZ	-69DB	Magnitude will be increase with increase in frequency
2	-941 HZ	-68 DB	
3	-965HZ	-69 DB	
4	-855 HZ	-66DB	
5	-878 HZ	-66DB	
6	-942HZ	Non-measurable	52% eccentricity
7	-877HZ	-75 DB	60% eccentricity
8	-942HZ	-82.5DB	20% eccentricity
9	-879HZ	-80.4 DB	25% eccentricity

IV.   METHODOLOGY

(A)   Current signature Analysis-

MCSA is used for condition Motoring in all rotating electrical machines. Randy R.Schoen et. al {29}describe the application of motor current signature analysis. The investigation finds out the stator current spectrum is described and related frequencies determined. The effect on the stator current spectrum analysis of the related frequency and result shows vibration and noise of a rotating machine with different levels of eccentricity. In most cases, the stator of the Induction Motor is easily observed using a power analyzer since it is used to save from over current fault, ground fault. Therefore current monitoring methods have been easily used without any sensor and also this can be used and any extra hardware
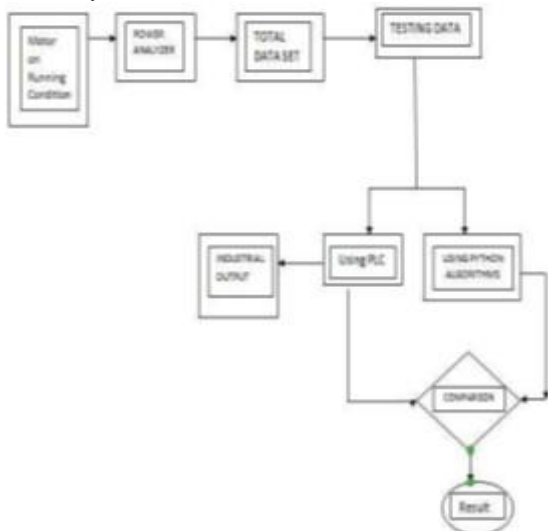

Figure 8: The Research approach

Hence design a historical signature to find out the nature fault nature. Spectrum Analysis using decision tree pattern analysis will make a easy path to motoring and and controlling the motor conditions[10] patterns analysis is a recognize method to set all spectrum in a proper manner so that we can apply decision tree method to set the kind of problem.

(B) Wavelet Analysis- Wavelet analysis-based detection method shows good analysis capability less detection and easily applied on fault identification josh A. Antonino et.al. research shows the diagnosis the rotor bar failures in Induction machine based on Stator current analysis using discrete wavelet transform(DWT). the analysis shows that if starting a transient is not very short then a bar breakage

problem will be the diagnosis. Iot Based sensor is used for monitoring system. this will not only save the cost of labours that also make the system is smart.[6]
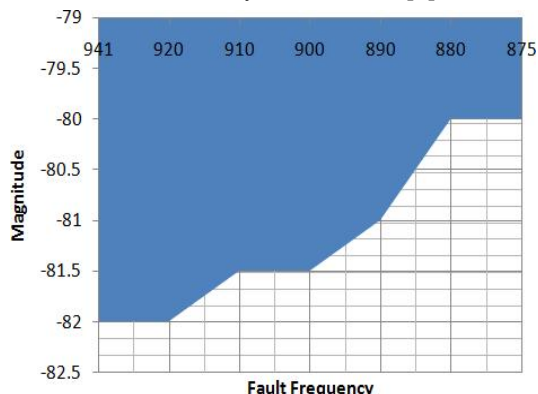

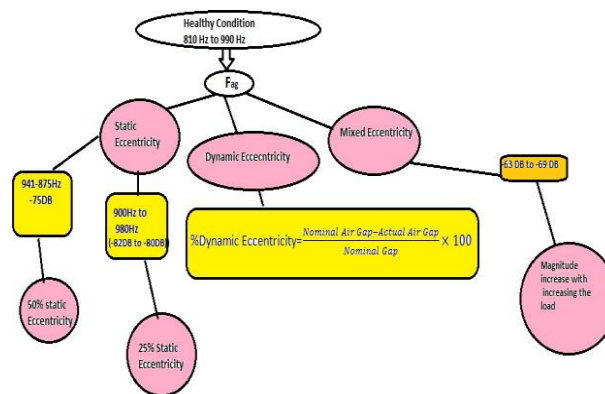
Fig 9: Fault Frequency Analysis

Fig 10: Decision tree of Air Gap Eccentricity

(B) A Platform for Machine Learning- Neural network technique has been used to identify the breakage and dynamic eccentricity three phase induction motor. the accuracy rate highly depends on number of data set then artificial neural network structure[4]**.** Machine learning is an intelligent system. It is useful for pattern recognition, prediction, and Optimization. The use of Machine learning For pattern recognition consists of Two Steps: first, the network is trained to learn using data set pattern and different condition. Decision tree utilized for online stability assessment. this method is employed for handling was quantity large data set which involve in information analysis system.[5]

V.   RESULT AND CONCLUSION

In this method decision tree help analysis of air gap is eccentricity using the decision tree algorithm. decision tree algorithm identifier detects 90% accurate value of air gap which is a gap between rotor and stator, in addition, the LabVIEW tools and power analyzer library is used for searching the maximum accurate parameter for achieving the result. the real-time data set from 0.5 HP. 210-volt three-phase induction motor which rotor is a squirrel cage type is used for spectrum and test this using decision tree algorithm.

FUTURE WORK

Testing the decision tree algorithm for all faults in various rotating machines also apply this method in a different electrical machine like Transformer as well as generator

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