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Fault Detection and Analysis in Bearing Using Vibrations

Prof.Nishikant.B.Patil, Saurabh Magar, Ganesh Lambate, Yashraj Pandhare, Jitesh Sanghavi
Department of Information Technology, PESMCOE, Pune, Maharashtra, India

Abstract - Over recent decades, predictive maintenance's usage attracted the attention of maintenance specialists in some important industries. Moreover, machinery condition monitoring is an effective indicator for planning maintenance schedules. Machine monitoring or early detection of incipient fault is an important judgment tool for the machine's health at critical parts such as; gears and bearings. Furthermore, the vibration monitoring process can be achieved by experienced operators using their visual inspection.

Key Words**: Industry 4.0, Predictive Maintenance, Bearing**

1.INTRODUCTION

Bearing is one of the important components in Rotary machines and has been widely used in various industries in many applications such as shaft mountings, to reduce friction as well as facilitate relative motion between the two components, etc. It is therefore essential to determine the early fault conditions from bearings. There are various methods to detect faults in the bearings, such as vibration monitoring, wear debris monitoring, temperature monitoring, soap techniques, non-destructive tests, etc. Vibration signal analysis may be one of the commonly used techniques for checking the condition and finding faults in bearings. CM techniques of ball bearings are used to detect the main effective dynamic characteristics of fault such as frequencies, mode shape, and damping. There are four faults according to the bearing's fault location namely in, the outer race, inner race, balls, and cage as mentioned by Grajales et al. Besides, the ability of these faults' characteristic frequencies; can be used as an important factor in early damage prediction.

Common types of bearing faults (such as wear, cracks, spalling)

Characteristics of fault-induced vibrations Relationship between fault severity and vibration features Vibration-Based Fault Detection Techniques

2. LITERATURE SURVEY

I]KiranKumar M V, M Lakesha, Sujesh Kumar and Ajith Kumar Review on Condition Monitoring of Bearings using vibration analysis techniques. Vibration analysis has been used as a predictive maintenance procedure in the machine maintenance. By adopting appropriate signal processing techniques, changes in vibration signals due to faults can be detected to aid in maintaining the bearings health condition. By detecting and analysing the machine vibration, it is possible to determine and predict the machine failure.

II] Juan-Jose Saucedo-Dorantes. Condition Monitoring Method for the Detection of Fault Graduality in Outer Race Bearing Based on Vibration-Current Fusion, Statistical Features and Neural Network. Bearings are the elements that allow the rotatory movement in induction motors, and the fault occurrence in these elements is due to excessive working conditions. In induction motors, electrical erosion remains the most common phenomenon that damages bearings, leading to incipient faults that gradually increase to irreparable damages. Thus, condition monitoring strategies capable of assessing bearing fault severities are mandatory to overcome this critical issue.

III] Osama Abdeljaber, Sadok Sassi. Fault Detection and Severity Identification of Ball Bearings by Online Condition Monitoring. The paper presents a fast, accurate and simple systematic approach for online condition monitoring and severity identification of ball bearings. This approach utilizes compact 1D convolutional neural networks (CNNs) to identify, quantify, and localize bearing damage.

IV] Matthias Kahr. Condition Monitoring of Ball Bearings Based on Machine Learning with Synthetically Generated Data.Rolling element bearing faults significantly contribute to overall machine failures, which demand different strategies for condition monitoring and failure detection. Recent advancements in machine learning even further expedite the quest to improve accuracy in fault detection for economic purposes by minimizing scheduled maintenance. Challenging tasks, such as the gathering of high quality data to explicitly train an algorithm, still persist and are limited in terms of the availability of historical data.

3.METHODOLOGY

3.CALCULATION:

DESIGN OF BEARING: -

Total radial load

F_r = 100kg Fr = 1000 N

Total dynamic load

$P = XF_r + YF_a \times Ka$

X = 1

Ka = 1 (Inner race is rotating)

F_a = 0 Y = 1

Hence

P = [(1×1000) + (0×0) × 1]   P = 1000N.

Total life in hours for the agricultural application considered

L_{10} = 10,000 Hr

Life in millions of revolutions = $\frac{60 \times N \times Lh}{10^6}$

= 60×30×10000

L_{10} = 18 million revolutions

So total dynamic capacity

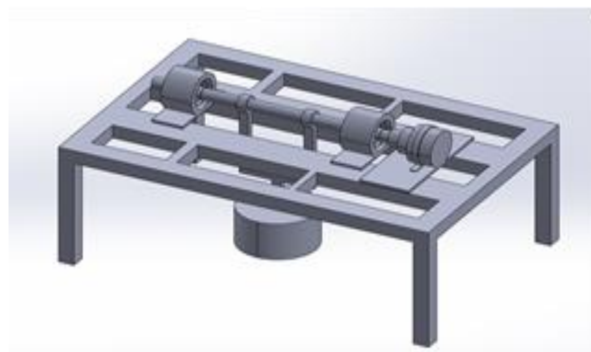
$C = P\,(L_{10})^{1/3}$

$C = 1000 \times (18)^{1/3}$

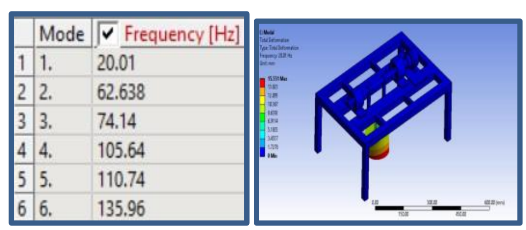
C = 2620 N

from the 20mm shaft diameter SKF 61904-2rs1 deep groove ball bearing is selected. The dynamic capacity of the bearing is up to 6.4KN.

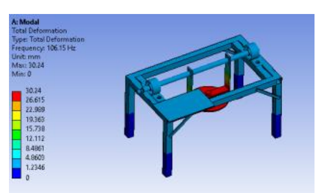
4.SOLIDWORKS DESIGN:

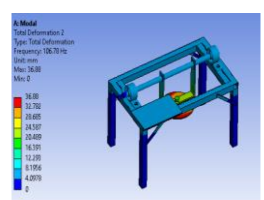


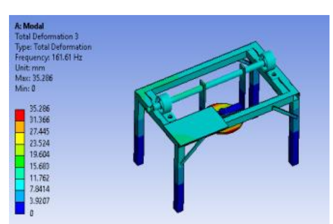
5.ANALYSIS:

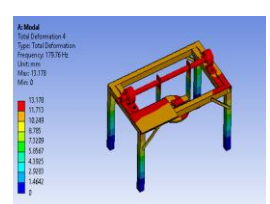


	Mode	Frequency [Hz]
1	1.	20.01
2	2.	62.638
3	3.	74.14
4	4.	105.64
5	5.	110.74
6	6.	135.96









C]ESP32 MICROCONTROLLER D]BEARNING

6.RESULT:

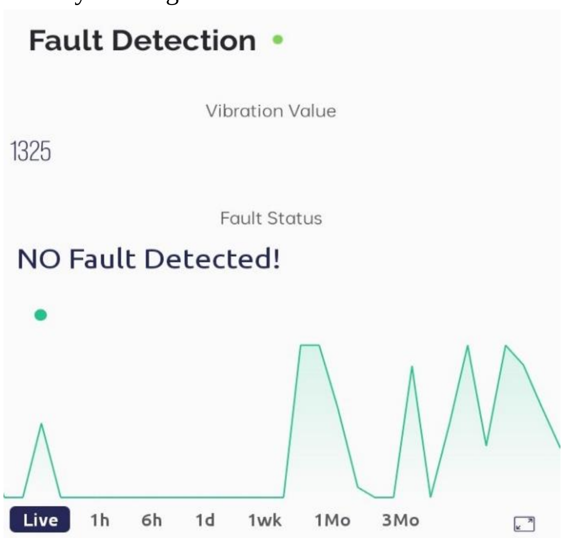
Table model analysis of whole bearing test rig setup

1.Fundamental frequency of structure has frequency is 106 hZ.

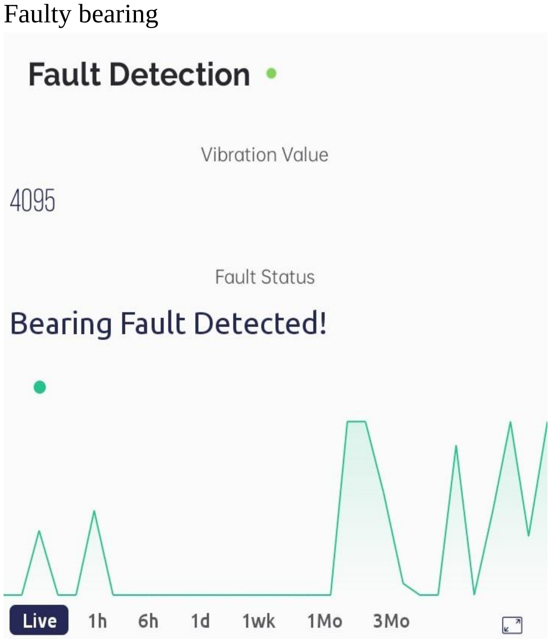
2.With the help of mechanical & mechatronics component we build small bearing test setup.

3.From the reading of vibration sensor it was conclude healthy bearing reading 3000 & Faulty bearing above 3000.

Healthy Bearing



Faulty bearing



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