Vibration Analysis of Air Compressor using LabVIEW

Ashok Kumar TN[1] Chethan V[2] Kumar[3] Mukesh P[4] Shashikanth G S[5]
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Nagarjuna College of Engineering And Technology, Bangalore

Abstract— Vibration Signature Analysis is one of the most useful tool used in condition monitoring. Condition monitoring is been evolving since long time. The failure of the reciprocating element interrupts the operation due to shutdown of the machine. The reciprocating element are commonly find their application in automobile industries, production plant, power sectors, chemical industry, reciprocating compressors, pumps etc. The reciprocating element are operating under high pressure and temperature conditions and there are many chances of this components failing before any warnings due to vibrations and their failure results in shutdown of the machines. Since these components are critical, their failure have consequence on cost. Monitoring is done by using two Analysis software's that is LabVIEW. The results obtained in both the software are checked for their compatibility to integrate both the software and develop a single maintenance system at less operating cost.

Keywords: Internet of things, GIS-Geographic information system, GUI – Graphical User Interface, MCU-Microcontroller, WSN-Wireless Sensor Network

I. Introduction

The air compressor is a positive displacement compressor and has been widely used in gas industries. One of the major advantages of the twin screw compressor is its flexibility under various operation conditions, , we have use Multi-Stage Compressor feature two or more piston cylinders, and each of a different diameter , After the first compression stage Air passes through a heat exchanger, where it is cooled before arriving at the second cylinder, Cooling the air reduces the work needed to compress it during the second stage considering the working temperature and gaseous pressure as well as the contact force between two screw rotors. The thermal-structural coupling method is applied to analyze the rotor deformations and loads, as there are many changes on operating clearance due to thermal loadings.

II. Project Aim and Objectives

A. Project Aim

The aim is to determine the vibration of air compressor using LabVIEW software

1) Necessity of measuring vibration

- Higher productivity demands increases the operating speeds, economical designs and lightweight structures, which makes the occurrence of resonance condition more often and to reduce the reliability. Therefore, the frequent vibration measurements are required for safety limitations.
- Any shift in the vibration characteristics or the shift in natural frequencies will indicate the failure or need for maintenance.
- Vibration measurement is necessary in order to select the operating speed to avoid resonance.
- As assumptions are made in theoretical calculations of vibration characteristics of a system the actual values may be different in analysis.
- The input and output measurements of vibration characteristics helps in identifying the system.

B. Objectives

To achieve this goal, we follow that type of intention:

- To determine the Air compressor vibration using LabVIEW.
- To analysis the vibration signals using accelerometer.
- Data acquisition and signal conditioning.
- Feature selection using decision tree and testing data

III. Literature Review

Ashok Kumar tn [1], Chetan V [2] they have given the condition monitoring system for roller bearing by using LabVIEW and MATLAB at different loads and speed. The vibration data is analyzed in frequency domain.
Kumar[3], Mukesh P [4] they gave the concept of condition monitoring of heavy machineries by using remote location. The condition monitoring can be done using software by web based control and LabVIEW.

Shashikant G S[5] and Mukesh P[4] Using vibration analysis the fuel injection faults of Internal Combustion Engine is determined and its propagation to the main structure in time domain, frequency domain and angle frequency domain. The fault is indicated by comparing the obtained signals of faulty engine by reference signal using Fast Fourier Transform Analyser.

Mukesh P [2] gives an idea of condition based maintenance of MAZAK 3-axis CNC milling machine by using vibration signature analysis and MATLAB software. According to Hansen I.H the maintenance cost is the second largest cost of the organization budget. Vibration signature analysis is most commonly used technique in condition based maintenance which give information about machine condition to detect the problem and overcome failure.

Ashok Kumar tn, Chetan V, Kumar They presented the test system for quality control of single suction centrifugal pump by using LabVIEW for Thai manufacturing line .the real time data, pump testing and test procedures are based on LabVIEW the test is carried out on an individual pump for expected head and system generates test procedures to maintain the quality.

IV. Experimental Setup

From these networks, we get knowledge about those are sensing, processing, transmission, power supply. From these networks, we get knowledge about the surrounding and pass it on to the base of the piston rod is connected to a small link of length 40 mm and big link of length 80 mm, width 20 mm and thickness of 5 mm which is made of Mild Steel all

the parts are connected by using high tensile half threaded bolts and nuts.

The accelerometer is mounted on the reciprocating element, which is connected to NI-DAQ-9234 Data Acquisition Card, and the output cable from the Data Acquisition Card is further connected to the computer system. The computer system consists of hardware drivers and software like LabVIEW which store, analyze and display the output.

Fig. 1: Compressor Indicator board

A. One Procedure for conducting Test

The following are the steps involved for obtaining real time acceleration values.

Step 1 : Accelerometer is fixed on the reciprocating firmly with the help of bees wax

Step 2 : Accelerometer is connected to DAQ card port for example ai0, the DAQ system consist of four ports the output of DAQ is connected to computer USB port. The signal is analog in nature, which is converted to digital by using Analog to Digital Convertor in Data Acquisition system.

Step 3 : To acquire the data form DAQ the computer contain software LabVIEW that store, analyze and display the output signal on the front panel in the waveform graph.

Step 4 : The circuit diagram for acquiring signal in LabVIEW by using G programming is developed the signal is in digital form of acceleration.

Step 5 : The experiment is conducted for different operating speeds and duration.

Step 6 : The experimentation work is stopped for specific duration for example 5 sec and the data, which is real time acceleration data is exported directly from graph and excel sheets using write to measurement files in LabVIEW.

Step 7 : The graphs are captured for reference, as shown in the below figure

Fig. 2: Air compressor

B. Work carried out so far

(1) Diagnosis Air compressor vibration using LabVIEW.
(2) Determined Vibration signal using accelerometer.
(3) Data acquisition and signal conditioning.
(4) Air compressor diagnosis result.

C. Work done to reduce the vibration

(1) Platform welding.
(2) Adding additional bushes and tightening of the bolts.
(3) Replacing the wheels into the stand in order to reduce the movement.
(4) Replacing the drive belt

D. Work carried throughout the experiment

(1) Analyzing the vibration data range of the air compressor.
(2) Implementing additional equipment or adding extra device in order to reduce the vibration
(3) Diagnosing the experiment again and verifying the data

V. METHODOLOGY

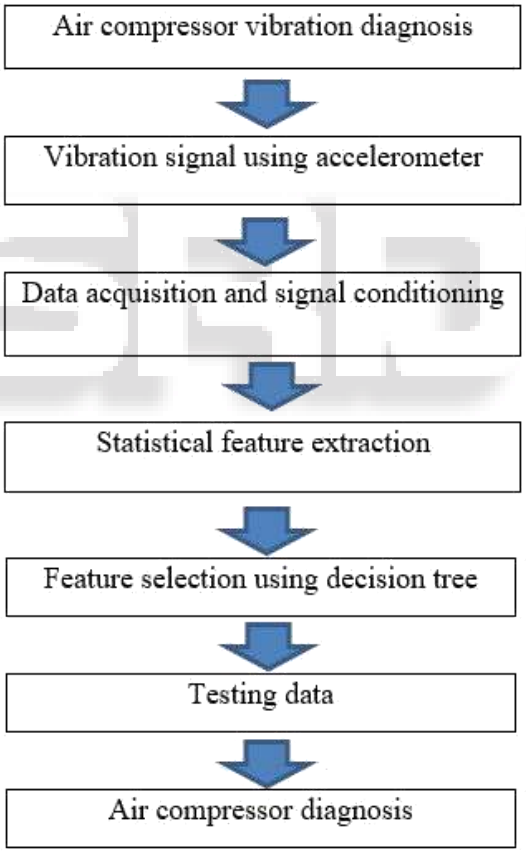

Fig. 3: flowchart of Vibration analysis

The above figure shows flow chart followed to carry out the work, LabVIEW software is used for analysis of vibration of air compressor tool. The optimization process is followed depends on material, size and loading conditions. At last, clear statements as to give on proposed work for betterment and advancement for selected applications

VI. RESULTS

A. Results of vibration before the work

Sl No	RPM	Trail No	Time in (sec)	Maximum acceleration m/s	Avg Maxi acceleration m/s	Minimum acceleration m/s	Avg Min acceleration m/s
1		1	10 sec	1.32442		-3.89815	
2	400	2	10 sec	1.54622	1.4826	-3.50312	-3.67694
3		3	10 sec	1.57744		-3.62955	
4		1	10 sec	1.37107		-1.89333	
5	600	2	10 sec	1.54313	1.49205	-1.67688	-1.822773
6		3	10 sec	1.56197		-1.89811	
7		1	10 sec	1.43860		-3.46511	
8	800	2	10 sec	1.00531	1.32503	-3.88531	-3.44914
9		3	10 sec	1.53119		-2.9970	

Table. 1: Results before the work carried out

B. Post results after the work done in order to reduce the vibration

Sl No	RPM	Trail No	Time in (sec)	Maximum acceleration m/s	Avg Maxi acceleration m/s	Minimum acceleration m/s	Avg Min acceleration m/s
1		1	10 sec	0.91442		-2.11815	
2	400	2	10 sec	1.33422	1.21202	-2.11202	-2.38657
3		3	10 sec	1.38744		-2.42955	
4		1	10 sec	0.99907		-1.32223	
5	600	2	10 sec	1.04413	1.01505	-1.40028	-1.37854
6		3	10 sec	1.00197		-1.21311	
7		1	10 sec	1.00860		-2.68511	
8	800	2	10 sec	0.90931	1.01636	-2.76531	-2.66571
9		3	10 sec	1.13119		-2.54670	

Table. 2: Results after the work carried out

VII. CONCLUSION

Based on literature review it has been found that vibration signature analysis is one of the most useful techniques used in condition monitoring and it is done either on LabVIEW software. There are provisions were we can integrate both the software to obtain useful results from vibration signatures which are obtained from the reciprocating element.

The experiment was conducted for vibration signature of piston and cylinder with cylinder diameter of 40mm and stroke length 100mm by using LabVIEW software to determine safe band of vibration for maximum and minimum amplitude operating at different speeds. If there is any deviation in the vibration pattern from the safe band the necessary corrective actions can be taken before failure to avoid breakdown. The results obtained from LabVIEW software are found to be compatible with each other and hence both the software can be integrated for future analysis.

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