VIBRATION DETECTION AND ANALYSIS FOR FAULT PREDICTION OF ELECTRIC ROTATING MACHINES

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Abstract - Vibration may influence the durability and reliability of machinery systems and cause problems such as damage, abnormal stopping and disaster. Vibration measurement is an important countermeasure to prevent these problems. A prior knowledge that a machine might breakdown soon may keep you well prepared to handle the losses or surprises. Vibration analysis increases the product quality, reduces production and maintenance cost and reduces risk. The objective of this study is to detect and analyze the vibration anomalies of machinery to aid predictive maintenance of the machinery, reducing breakdown time and improving efficiency.

I. INTRODUCTION

Industries of this modern era are mainly concerned with quality and quantity of prediction over a period of time. Together with production requirements, an industry works to achieve its long and short term goals which determine the success or failures of that particular year. Almost every industry has incorporated the use of motor to accomplish its operational requirements. Motors are an essential machine and it also has a tendency to fail at some time [8]. As a general rule, machines do not breakdown or fail without some form of warning, which is indicated by an increased vibration level. By measuring and analyzing the vibration of a machine, it is possible to determine both the nature and severity of the defect, and hence predict the machines failure [2].

The main aim of this study is to do predictive analytics of machinery and to reduce breakdown period of it. Vibration analysis of electrical machine is one of the very essential techniques for fault finding. Condition monitoring (CM) is an important enabler for predicting potential failures in high precision machining facilities [1]. It is a maintenance process for monitoring the specific parameter like vibration of equipment for early sign of coming failure and to forecast the need of maintenance before failure to estimate the machines health [4].

In vibration analysis, vibration of machine assembly or a specific part are recorded using sensors such as accelerometer. These recorded vibrations are analyzed to estimate for how more time the part or machine could work without any issues. We can have a visualization and estimation about working state of the machine by means of vibrations. Therefore predictive maintenance using vibration analysis provides the condition of components in operating machines. If the fault occurs in component, continuous vibration analysis can find possible fault, and respective action can be taken to keep system in operation. Hence vibration analysis provides faster, continuous and efficient fault prediction.

A. System Design

Fig. 1. Flowchart of the overall vibration detection system.

II. METHODOLOGY

Block diagram of the project "Vibration detection and analysis for fault prediction of electric rotating machines" is described in this chapter.

Fig 2. Block diagram of vibration detection system.

Vibration detecting system provides a monitor method for the equipment in normal work condition. The vibration level of the machine is measured with the help of high precision sensor that is MPU6050 accelerometer sensor. it is a complete six axis motion tracking device, it combines 3-axis accelerometer, 3-axis gyroscope and digital motion processor all in small package. Vibration data is collected by using MPU6050 sensor from the operation performed by the drilling machine, Ac induction motor and CNC drilling machine. , MPU6050 to ESP32 communication is through I2C serial port. after collecting the data, thresholds for each operation is detected. Analysis is carried out based on threshold values detected. Based on threshold value we can predict faults of machine. The information or data from the sensor goes to the gate way through RS485 communication. RS485 is a duplex communication system in which multiple devices can communicate with the same bus in both directions and long data transfer over distance of up to 4000 feet. It has excellent noise free and is ideal for industrial and commercial applications. We get alert notification in dashboard when the vibration of a machine reaches threshold value.

III. MOUNTING THE SYSTEM

Fig 3. Sensor mounting on drilling machine.

Fig 4. Sensor mounting on CNC drilling machine.

Fig 5. Sensor mounting on AC induction motor.

IV. TESTS AND RESULTS

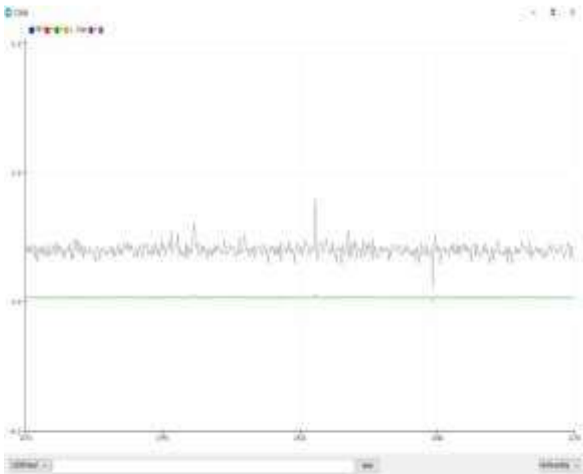

Fig 6. Fast Fourier Transform and RMS value of vibration signal of drilling machine under normal operation.

In the above figure the green and blue signals shows the FFT and RMS value of drilling machine.

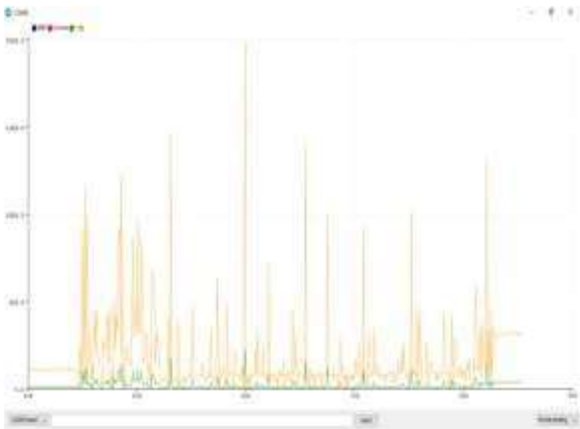

Fig 7. Fast Fourier Transform and RMS of vibration data of faulty drilling machine.

In the above figure the green and orange color signals shows the FFT and RMS value of faulty drilling machine.

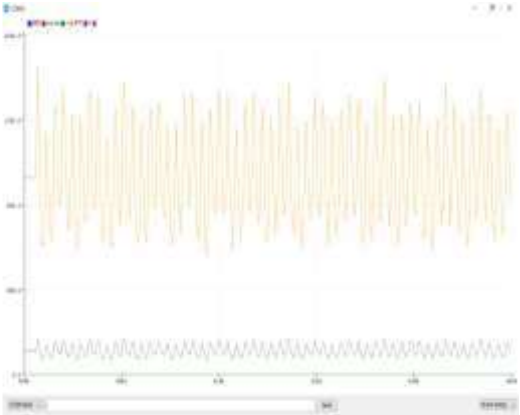

Fig 8. Fast Fourier Transform and RMS value of vibration of AC induction motor under normal working condition.

In the above figure the blue and orange color signals shows the FFT and Rms value of AC induction motor under normal working condition

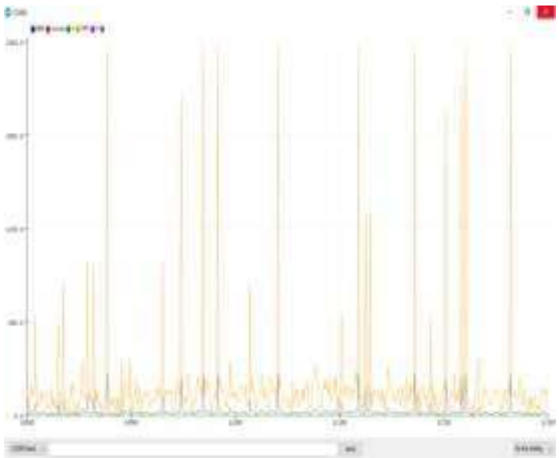

Fig 9. FFT and Rms value of vibration of faulty AC induction motor.

In the above figure the green and orange color signals shows the FFT and Rms value of faulty AC induction motor.

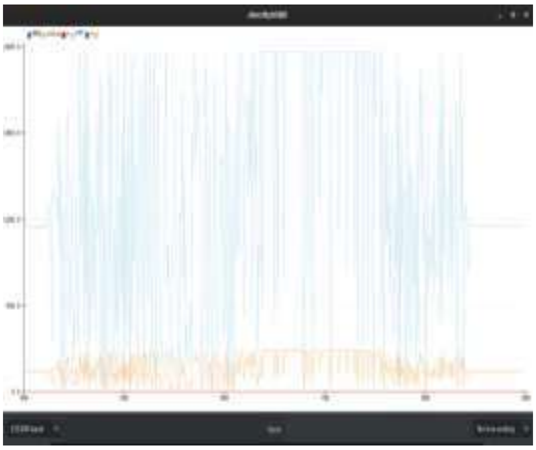

Fig 10. FFT and Rms value of vibration of CNC drilling machine under normal working condition.

In the above figure the red and blue signals shows the FFT and Rms value of CNC drilling machine under normal working condition.

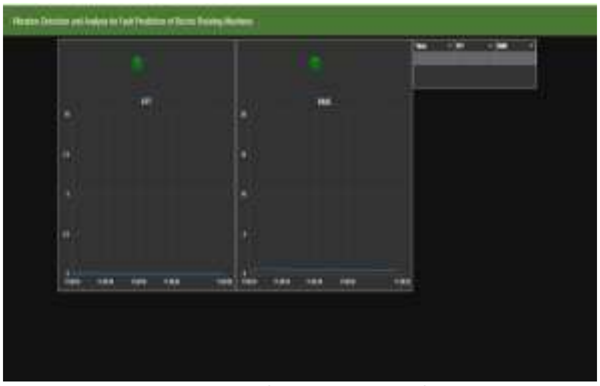

Fig 11. Dashboard display of FFT and Rms of machine under normal working condition.

Fig 12. Dashboard display of either FFT or Rms goes beyond threshold value when fault occur during operation of a machine.

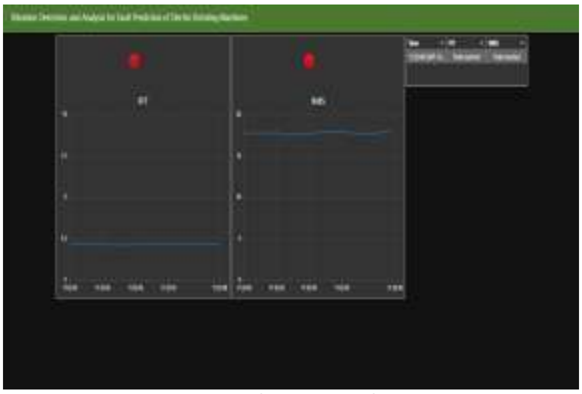

Fig 13. Dashboard display of vibration of a machine when both FFT and Rms value goes beyond threshold value when fault occur.

When fault occur or beyond threshold get a alert notification in the dashboard with the time at which the threshold reached and a message “peak reached”.

V. CONCLUSION

The vibration analysis for faults prediction using FFT and Rms value is determined experimentally. In order to keep away from losses coming from a non programmed stop or from material damage, early fault detection becomes essential. The vibration analysis technique is the confluence of the predictive maintenance technique. Vibration analysis is a sufficient technique for monitoring the health of machinery by comparing the vibration data for fault case to that of a healthy machine.

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