Condition Monitoring Based Control Using Piezo Sensor for Rotating Electrical Motors

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Abstract: A protection system for rotating electrical motors through condition monitoring to indentify the problem the problematic source in the motor and to protect due to excessive vibration without human observation. Maintenance of electrical motors is important the condition monitoring of motor is gaining importance in industry to reduce the downtime time costs and increase motor reliability. In the work a simulation model has been developed using piezoelectric sensor for condition monitoring to detect the problem .If any problem is occurred in any location in the motor then vibration of the whole system increases. It extracts the maximum value of vibration signals coming from different bearing positions of the motor. If the magnitude of vibration is in 'unacceptable' range. If the value of vibration is in 'unsatisfactory' range then an alert on the computer screen .The 'unsatisfactory' and 'unacceptable' condition it displays of defective bearing. This system not only protects the unscheduled shut down of motors but also increases the lifetime of motor components.

Keywords: Condition Monitoring, Vibration Analysis, and piezoelectric sensor.

I. INTRODUCTION

Rotating electrical motors are the important components in industry. A vibration detection device includes a detecting device for detecting a vibration, and an output from the amplifying device obtained when outputting a detection signal on the basis of the detection result, an amplifying device for amplifying the detection signal, an initializing device for initializing the output from the amplifying device, and an adjusting device for adjusting the output from the amplifying device so that an output from the amplifying device obtained when the amplifying device is initialized, and an output from the amplifying device obtained when the amplifying device is not initialized and the detecting device generates no signal have substantially the same values.

A machine having a vibration control device machine comprising sync signal generating means for generating a sync signal in synchronism with rotation of an arm shaft of said sewing machine vibration detecting means for detecting vibration generated on a machine body of said machinecontrol vibration generating means capable of generating control vibration for cancelling the vibration generated on said machine body transfer function setting means for preliminarily setting a transfer function he unscheduled down caused by a failure of motors can cause enormous costs.

Energy loss increases due to unscheduled down of motor and it increases economical losses [1]. The energy losses ac come from the unscheduled downtime by the unexpected motor failures. The most common types of faults in rotating electrical motor have been found using failure. Application of condition monitoring system for motors is increasing industry due to the need to increase motor reliability and decrease the possible loss of production due to motor breakdown. Now, application of motor condition monitoring is increasing to reduce both unexpected failures and maintenance costs.

RESEARCH PURPOSE
The modern automobile consists of many mechanical system s such as power seats, windshield wipers, mirrors, trunks, and windows, which are all susceptible to breakdown. Without any condition monitoring system, the breakdown is usually catastrophic, and requires an expensive part replacement. Real -time condition monitoring allows for early detection of faults, which could require a simple solution such as the application of a lubricant to fix. This prolongs the useful life of the component, and prevents sudden and unexpected failure. Real-time condition monitoring can be accomplished by examining the vibration signature of a mechanical system.

For example, an auto mobile power window consists of a DC motor and its associated bearings and couplings, a gear reduction system consisting of worm and spur gears, and kinematic links. Faults resulting in excessive vibrations may be caused by coupling misalignment, bearing failure or gear train failure. Coupling misalignments occur at the connection between the drive shaft and the driven shaft, and are typically due to imperfect manufacturing. Bearing failure is caused by lack of lubrication or moisture contamination causing rusting, while gear train failure is caused by misaligned, broken, cracked or chipped gear teeth [1]. Each fault occurs at a characteristic frequency, and so the state of the mechanical system can be determined by monitoring the amplitudes of the relevant frequencies. Vibrations due to coupling misalignments occur at harmonics of the shaft rotational speed. Gear vibrations occur at the gear turn speed or at sidebands of the gear mesh frequency [1].Ball bearing vibrations.

II. VIBRATION ANALYSIS

Indicative of characteristics of mechanical parts and electrical parts of said sewing machine and vibration control means for controlling said control vibration generating means so as to minimize the vibration detected by said vibration detecting means according to the sync signal generated from said sync signal generating means, the transfer function set by said transfer function setting means, and a detection signal from said vibration detection means. The machine according to claim 1, wherein said vibration detecting means comprises a plurality of vibration detecting means for simultaneously detecting vibrations generated at a plurality of positions on said machine body, said control vibration generating means comprises a plurality of control vibration generating means for generating control vibrations for simultaneously cancelling the vibrations generated at said plurality of positions on said machine body, and said vibration control means controls said plurality of control.
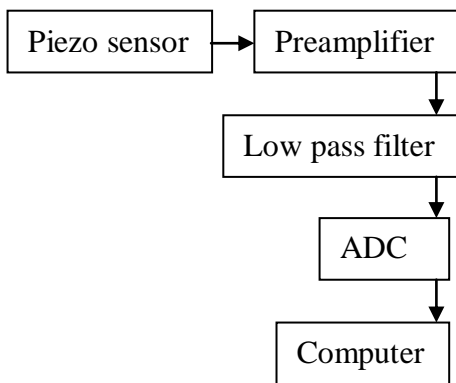
III. PROPOSED SYSTEM

Fig1. System Diagram

Analog to Digital Converter:
 An A/D converter is used to convert the analog electrical signals to digital signals. An A/D converter using AD IC with 8 bit resolution and conversion time of 25 microsecond was used for this purpose. The digitized output from the ADC is then fed to the computer where the analysis can then be done to detect abnormalities if any. Piezoelectric transducer has very high DC output impedance and can be modeled as a proportional voltage source and filter network. The voltage V at the source is directly proportional to the applied force, pressure, or strain.[7] The output signal is then related to this mechanical force as if it had passed through the equivalent circuit.
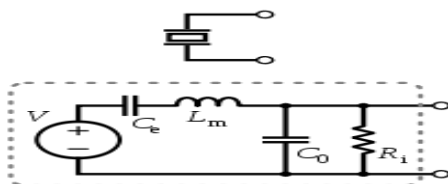

Fig 3 .Frequency response of a piezoelectric sensor; output voltage vs applied force

A detailed model includes the effects of the sensor's mechanical construction and other non-idealities.[8] The inductance L_m is due to the seismic mass and inertia of the sensor itself. C_e is inversely proportional to the mechanical elasticity of the sensor. C_0 represents the static capacitance of the transducer, resulting from an inertial mass of infinite size.[8] R_i is the insulation leakage resistance of the transducer element. If the sensor is connected to a load resistance, this also acts in parallel with the insulation resistance, both increasing the high-pass cutoff frequency.
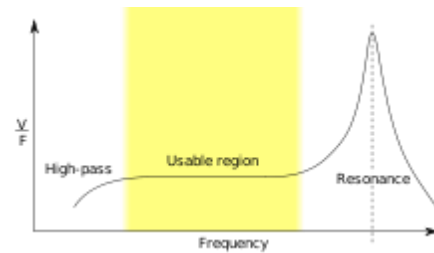

Fig.4 Frequency Graph

In the flat region, the sensor can be modelled as a voltage source in series with the sensor's capacitance or a charge source in parallel with the capacitance For use as a sensor, the flat region of the frequency response plot is typically used, between the high-pass cut-off and the resonant peak. The load and leakage resistance must be large enough that low frequencies of interest are not lost.

A simplified equivalent circuit model can be used in this region, in which C_s represents the capacitance of the sensor surface itself, determined by the standard formula for capacitance of parallel plates. It can also be modelled as a charge source in parallel with the source capacitance, with the charge directly.
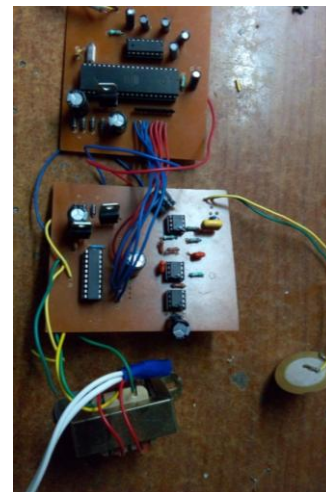

Fig.5 Project model

Condition Monitoring System
Condition monitoring means to access the actual Condition of motor using the measurements taken while the motor is operating.
Here mainly use two types of condition monitoring technique to detect different fault Current and vibration monitoring.

This is the method for fault diagnosis. In this stage, First of all we create different fault (such as bearing fault, unbalance voltage) due to which symmetry of motor would effect and creates fault characteristics frequency. After that we get that fault frequency by different type of sensors (such as for vibration signal we can use piezoelectric accelerometer, for speed measurement tachometer etc.

Bearing Fault in Induction motor
Bearing are common elements of Induction Machines. They are employed to permit the rotary motion of the shaft. The bearing mainly consists of two rings called the inner and outer rings. A set of balls or rolling elements placed in raceways rotate inside these rings. A continued stress on the bearings cause fatigue failures, usually at the inner and outer races of the bearings. Small pieces break loose from the bearing, called flaking or spalling.

These failures result in rough running of the bearings that generates detectable vibrations and increased noise levels. And this process is helped by other external sources including contamination. Corrosion, brinelling, improper lubrication, improper installation. In some case shaft voltage and current are also sources for bearing failure. High bearing temperature is also another reason for bearing failure.

IV. CONCLUSION

The model is useful for all motors in condition monitoring system. The vibration data of motor is used as a case study. It is not only useful to predict problems but also protects motor from breakdown. It also identifies and displays the problem in the motor without any human intervention. Excessive vibration can damage the motor components. So, this system will increase the motor lifetime.

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