A REVIEW APPROACH ON MACHINE HEALTH MONITORING AND MAINTENANCE SYSTEM

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Abstract:

We review existing machine condition monitoring techniques and industrial automation for plant-wide condition monitoring of rotating electrical machines. Cost and complexity of a condition monitoring system increase with the number of measurements, so extensive condition monitoring is currently mainly restricted to the situations where the consequences of poor availability, yield or quality are so severe that they clearly justify the investment in monitoring. There are challenges to obtaining plant-wide monitoring that includes even small machines and non-critical applications. One of the major inhibiting factors is the ratio of condition monitoring cost to equipment cost, which is crucial to the acceptance of using monitoring to guide maintenance for a large fleet of electrical machinery. Ongoing developments in sensing, communication and computation for industrial automation may greatly extend the set of machines for which extensive monitoring is viable.

Keywords**:** Health Monitoring, Motor Faults, maintenances of the system.

I. INTRODUCTION

Condition Monitoring (CM) is a process of acquiring equipment health status and predicting the operational ability of a system in a given environment: the health of the system is evaluated during its operation, and possible failures associated with it are recognized at an early stage. Motivations for condition monitoring (CM) in industrial automation include reductions in downtime, maintenance activity and related faults, and increases in energy efficiency, yield, and quality. Predictive diagnostics based on CM permit a well-informed plant maintenance activity. Condition based maintenance (CBM) using the equipment condition assessment has several benefits as compared to scheduled cyclic or reactive plant maintenance, mainly in terms of reduced downtime and replacement cost. The methods used in system health assessment depend on plant infrastructure, operational criticality, process work flow, and ease of repair and service. The monitoring of the distributed rotating electrical machines such as smart motors sending fault information wirelessly may demand modification of the legacy CM practices. This paper reviews the traditional condition monitoring techniques, recent activities, and deployment of the intelligent machines in an industrial automation system. It covers the evolution and recent trends regarding rotating electrical machines, as well as deployment use case for plant-wide operations and future directions. In reference paper, in paper the author had done this project on Atmega328 microcontroller. This system can fault detection for industrial motor that combine vibration, motor current and temperature analysis. Author use temperature sensor LM35 current sensor is hall effect-based DC current sensor (measuring range 5A) thus sensor detection detects mechanical fault the design also considered the time of detection and further possible actions, which are also important for the early detection of possible malfunction. The deployed network uses the beacons enable mode to synchronize several sensor nodes with coordinate node and guarantee time slot mechanism provide data monitoring with predetermined latency.

II. LITERATURE SURVEY

In paper [1] the author had done this project on Atmega328 microcontroller. This system can fault detection for industrial motor that combine vibration, motor current and temperature analysis. Author use temperature sensor LM35 current sensor is hall effect-based DC current sensor (measuring range 5A) thus sensor detection detects mechanical fault the design also considered the time of detection and further possible actions, which are also important for the early detection of possible malfunction. The deployed network uses the beacons enable mode to synchronize several sensor nodes with coordinate node and guarantee time slot mechanism provide data monitoring with predetermined latency. the beacon enables mode of IEEE 802.15.4 standard is use since it synchronizes the communication between coordinator node and the sensor node, this approach ensure that the data has been send, which is essential in this application.

In paper [2] the author had done project based on acoustics emmition (AE) signal based technique rotational machine health monitoring and diagnostics done to the advantages of the AE signal over than the extensively used vibrational signal unlike vibration based method technique are in their infant stage of development from the perspective of the machine health monitoring and fault detection developing an AE based methodology. In this paper methodology for rotational machine health monitoring system and fault detection using empirical mode decomposition (EMD) based AE feature quantification is presented.

III. NEED OF HEALTH MONITORING AND TECHNIQUES OF HEALTH MONITORING

A. NEED OF HEALTH MONITORING

The continuous evaluation of the health of the equipment throughout its service life is called Health monitoring or condition monitoring. Most machinery is required to operate within a relatively close set of limits. These limits, or operating conditions, are designed to allow for safe operation of the equipment and to ensure equipment or system design specifications are not exceeded. They are usually set to optimize product quality and throughput (load) without overstressing the equipment. Generally speaking, this means that the equipment will operate within a particular range of operating speeds. The main reason for employing machine condition monitoring and fault diagnostics is to generate accurate, quantitative information on the present condition of the machinery. This enables more confident and realistic expectations regarding machine performance. Connecting equipment for monitoring can present a security risk when not done correctly, however doing so securely does not have to be expensive. Machine Metrics has worked and consulted with information technology (IT) security experts to make sure our system is safe. Those that connect to machine monitoring are increasing production by making better decisions driven by data, enabling better, real-time communication between management and the shop floor. The transparency of the system allows companies to acutely understand problems, bringing problems to the surface much quicker than before.

B. TECHNIQUES OF HEALTH MONITORING

There are a lot of methods which have already been used in the last four decades for health monitoring of the machine but most commonly used techniques are described below:

a. Thermal Monitoring:

The thermal monitoring of electrical machines can be completed by measuring local temperature of the motor or by the estimation of the parameter. Due to the shorted turns in the stator winding the value of stator current will be very high and hence it produces excessive heat if proper action would not be taken and results into the destruction of the motor. So, some researchers have introduced thermal model of electric motor. Basically, this model is classified into two parts:

I. Finite element analysis (FEA) based model
II. Lumped parameter-based model

FEA model is more accurate than the second model but it is a highly computational method and also time-consuming A lumped parameter-based model is equivalent to the thermal network and made from thermal resistances, capacitances and corresponding power losses. In a turn to turn fault, the temperature rises in the region of the fault, but this might be too slow to detect the incipient fault before it progresses into a more severe fault. The temperature monitoring technique has been used for bearing and stator fault detection purpose. This method provides a useful indication of machine overheating but offer limited fault diagnosis capability.

b. vibration Monitoring:

Vibration monitoring technique is the oldest health monitoring technique of the induction motor. It is widely used to detect mechanical faults such as bearing failures or mechanical imbalance. A piezo-electric transducer providing a voltage signal proportional to acceleration is often used. This acceleration signal can be integrated to give the velocity or position. Almost, all electrical machines generate noise and vibration. Therefore, researchers had been used this vibration for fault diagnosis purpose. They successfully diagnosed several faults from this vibration parameter. The vibrations also can produce due to the inter-turn winding faults, single phasing and supply voltage unbalance.

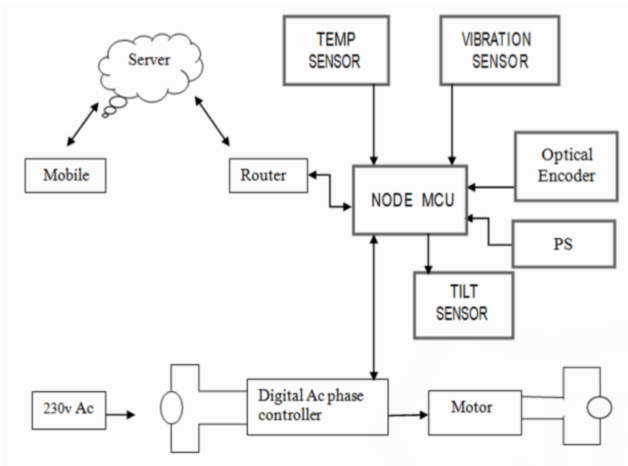
The radial forces due to the air gap field are largest sources of vibration and noise in electrical machines. Since, the air gap flux density distribution is product of the resultant emf wave and total permeance wave. The resultant mmf also contains the effect of possible rotor or stator asymmetries. The permeance wave depends on variation of the air gap as well, the resulting magnetic forces and vibrations are also depending on these asymmetries. Thus, by analysing the vibration signal of an electric machine, it is possible to detect various types of fault and asymmetries.

c. Noise Monitoring:

By measuring and analysing the acoustic noise spectrum we are able to do noise monitoring. Due to the air gap eccentricity the noise is produced. This noise is used for fault detection in induction motor. However, it is not the accurate way to detect the fault by noise monitoring because of the noisy background from the other machines. Ventilation noise is associated with air turbulence, which is produced by periodic disturbances in the air pressure due to rotating parts. The noise is due to the Maxwell's stresses that act on the iron surfaces. These forces are responsible for producing the noise in the stator structure.

IV. METHODOLOGY

The block diagram is a pictorial representation of system. It shows how the various essential components must be connected to fulfil the desired task. It describes the circuitry of monitoring system. It shows the main structure As we can see here we used NodeMCU E12 as controller which can process further we can use various type of sensor like vibration sensor Tilt sensor, Temp sensor, sensor sense the vibration and other parameter and predict the fault which may occur then we will get the indication message on the mobile application the mobile app shows that which fault is occurs and suggest the proper action the machine we used is continually outer observation all data store on the cloud.



A. AC Motor

As shown in figure single phase AC motor used here. The performance of the AC Induction motor depends on electrical, mechanical and environmental parameters of the motor, so that the controlling methods for high performance AC motor are very sensitive to motor parameters. All electrical, mechanical and environmental parameters like vibrations, temperature, and external noise of the induction motors are very important for a drive system. The performance of an induction motor is directly affected by the above-mentioned parameters

B. Vibration Sensor Motor

Accelerometers measure the acceleration or vibration of a device or system. Here we used vibration sensor for measured the vibration of the AC motor. Vibration in industrial equipment is sometimes part of the normal operation but sometimes it can be a sign of trouble. Hence the monitoring of the vibration AC motor is very important part of the project as we used AC motor. The sensitivity of these sensors normally ranges from 10 mV/g to 100 mV/g, and there are lower and higher sensitivities are also accessible.

C. Temperature Sensor

A temperature sensor is a device, usually an RTD (resistance temperature detector) or a thermocouple, that collects the data about temperature from a particular source and converts the data into understandable form for a device or an observer. Temperature sensors are used in many applications like HV and AC system environmental controls, food processing units, medical devices, chemical handling and automotive under the hood monitoring and controlling systems etc.

D. Digital AC Phase Control

AC Voltage Controllers (**ac line voltage controllers**) are employed to vary the RMS value of the alternating voltage applied to a load circuit by introducing Thyristors between the load and a constant voltage ac source.

E. Regulated Power Supply

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. A power supply may include a power distribution system as well as primary or secondary sources of energy such as Conversion of one form of electrical power to another desired form and voltage, typically involving converting AC line voltage to a well- regulated lower-voltage DC for electronic devices. Chemical fuel cells and other forms of energy storage systems.

Solar power.

V. CONCLUSION

In the present paper, the accurate health monitoring technique of the induction motor can improve the reliability and reduce the maintenance costs. It has been observed from previous years research papers that the fault diagnosis in the motor is still a challenging task for researchers and academicians Condition monitoring of rotating electrical machines has evolved with the advent of sensing, machine diagnostic methods, data analytics platforms, communication and information management. Developments in these technologies now give a fresh opportunity to obtain automation and monitoring systems suited to diverse plant deployment scenarios that would not previously have been possible. The paper reviews the deployment methods in practice that allow integration of monitoring system on premise, on cloud, and even rogue internet of things (IOT) devices in industrial automation systems

REFERENCES

[1] Gu, F.; Wang, T.; Alwodai, A.; Tian, X.; Shao, Y.; Ball, A. A new method of accurate broken rotor bar diagnosis based on modulation signal bispectrum analysis of motor current signals. Mech. Syst. Signal Process. 2015, 50, 400–413.

[2] "Condition Monitoring of Induction Motor using Artificial Neural Network", IEEE International Conference on Magnetics, Machines & Drives", 2014.

[3] Zagirnyak, M.; Mamchur, D.; Kalinov, A. Induction motor diagnostic system based on spectra analysis of current and instantaneous power signals. In Proceedings of the IEEE SOUTHEASTCON 2014, Lexington, KY, USA, 13–16 March 2014; pp. 1–7.

[4] "Predictive Condition Monitoring of Induction Motor Bearing using Fuzzy Logic", International Journal of Engineering Innovation & Research, Vol. 1, Issue 5, 2012,pp.451-454.

[5] Hess, Stephan M., et al., "An Evaluation Method for Application of Condition-Based Maintenance Technologies", 2001 Proceedings Annual Reliability and Maintainability Symposium, pp. 240-245.

[6] Thurston, M. G., "An Open Standard for Web Based Condition-Based Maintenance Systems", Autotestcon Proceedings, 2001.IEEE Systems Readiness Technology Conference, 2001, USA, Valley Forge, PA, 2001, pp. 401-415.

[7] Tsang, A. H. C., Condition-Based Maintenance: Tools and Decision Making, "Journal of Quality in Maintenance Engineering", Vol. 1, No. 3, 2001, pp. 3-17.

[8] Reichard, Karl M., et al., "Application of Sensor Fusion and Signal Classification Techniques in a Distributed machinery Condition Monitoring System", Sensor Fusion: Architectures, Algorithms, and Applications IV, Proceedings of SPIE, Vol. 4051, 2000, pp. 329336.

[9] Yam, R. C. M., Tso, P. W., Li, L., Tu, P., Intelligent Predictive Decision Support System for Condition-Based Maintenance, "International Journal of Advanced Manufacturing Technology", 2001, Vol. 17, Issue 5, pp. 383391.

[10] "Various Techniques for Condition Monitoring of Three Phase Induction Motor- A Review", International Journal of Engineering Inventions, Vol. 3, Issue 4, 2013, pp.