Early Fault Detection in Induction Motor

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Abstract- *Induction motors are the main workhorse of industrial prime movers due to their ruggedness, low cost, low maintenance, reasonably small size, reasonably high efficiency, and operating with an easily available power supply. About 50 % of the total generated power of a nation is consumed by these induction motors . This statistics gives an idea regarding the use of huge number of induction motors, but they have some limitations in their operating conditions. If these conditions exceed then some premature failure may occur in stator or/and rotor. This failure, in many applications in industry, may shut down, even, the entire industrial process resulting loss of production time and money. Hence, it is an important issue to avoid any kind of failure of induction motor. Operators and technicians of induction motors are under continual pressure to prevent unscheduled downtime and also to reduce maintenance cost of motors.*
We used python language for early detection of fault.So that we can detect fault in very less time.This article shows how we can detect fault using python.

Keywords: *induction motor,types of faults,method to detect fault.*

I. INTRODUCTION

Rotating electric motors are often used in industry,for example in oil refinery, pump oil, steel mill, mine, compressor .Induction motors are widely used electric motors in industry. It is a motivation to analyse such machines. The single-phase induction motor is one of the types of induction motor. Diagnostics of rotating electric motors is a normal process of maintenance. A degradation of electric rotating motors depends on environment operation time. Accidents, financial loss, unscheduled downtimes can be predicted based on early diagnostics of motors. A fault state is a state, which causes adverse effects from the point of view of the correctness of its operation. The early fault state is the state, in which there are symptoms of characteristic phenomena of the fault state In recent years monitoring of machines was developed by engineers and companies Online monitoring of machines also allows for intelligent maintenance with the optimised use of maintenance resources. In the literature the following types of faults of motors were mentioned: stator faults rotor faults rotor open phase, short circuits of windings, broken bars, faulty ring of squirrel-cage, increased resistance of connections, shaft misalignment, faulty bearings

II. TYPES OF FAULTS

ELECTRICAL FAULTS

Under or Over Supply Voltages Fault	This fault occurs when supply voltages are under or over the specific limit. The limit of three phase ac supply voltages is 380 to 440 so when supply voltages cross this limit then the motor could be burned or hearted up.
Over Load Fault	This fault is occurred when motor is overloaded means the higher load is connected at output side of motor and due to this load motor could be heat up orexcessive vibration .

Earth Fault	Earth fault occurs when any one phase ofsupply voltages is connected to the housing of the motor then the motor is totally shorted. In this condition when anyone will touch this motor then he will feel the heavy shock beside this, the motor would take over current that could be dangerous for an induction motor.
Inter Turn Short Circuit Fault	Inter turn short circuit fault is the such type of fault when two turns of same phase or different phases are short circuited. During this fault the motor couldbe totally damaged, or coils of that specific phase could be damaged.
Crawling Fault	Crawling fault is basically an electromechanical fault in a three phase induction motor. This fault occurs when the motor is fully loaded with full supply voltages then it does accelerate but it runs nearly one seventh of its synchronous speed. This specific phenomenon of the induction motor is called crawling.

MECHANICAL FAULTS

Broken Rotor Bar Fault	The squirrel cage induction motor consists of rotor bars and a shorted end ring. If these bars are damagedor partially cracked, then this type of fault is called rotor broken bar fault. There are so many reasons for this fault, but it has mainly been observed that this fault occurs due to a manufacturer defect. Because during the brazing process non uniform metallurgical stress may occur in rotor bars which may lead the rotor bars to failure during the rotation of the rotor.
Rotor Mass Unbalance Fault	If we concentrate on the construction of an induction motor then we can easily know that the rotor of the induction motor is placed inside the stator bore and it rotates coaxially with the stator. In heavy motors it is centrally aligned with the stator and its axis of rotation is also the same with the geometrical axis of the stator. So the air gap between inner of the stator and outer of the rotor is the same. Similarly, if this air gap is notthe same then the situation which is referred to as eccentricity would occur. In this eccentricity situation, the rotor fault would occur, which is called rotor unbalanced fault.
Bearing Fault	In three phase induction motors two sets of bearings are installed inside of motor housing, for supporting the motor shaft. The main purposes of these bearings are to rotate the motor shaft freely and reduce the friction. They consist of an outer and inner ring which is called races and a set of rolling elements which is called balls. The balls are fixed in an inner and outer side of the ring and they reduce the friction of the shaft. The fiction could be further reduced by the lubrication of these balls. Sometimes the balls, outer or inner ring of bearing is damaged due to any physical problem then the fault occurs. This fault is called bearing fault and due to this fault, the motor totally jammed or struck

ENVIRONMENTAL FAULT:

In three phase induction motor different faults could occur simultaneously and, in these faults, environmental fault is also so important .Induction motor surrounding environment such as ambient temperature and moisture etc. effect on the performance of induction motor. These factors reduce the performance of the induction motor.

Beside this, the vibration in an induction motor that could be due to any reason such as not properly installed also affects the performance of the induction motor. So during the installation of three phase induction this factor should be kept in mind.

III. METHODOLOGY

Minor symptoms of motor faults may cause lower efficiency, high energy utilisation, improper performance, and long-time equipment operating shutdown. Even minor faults can increase the loss chances such as reducing efficiency and increasing motor temperature, which will reduce the winding insulation lifespan and increase motor vibration. They are caused by the operating environment circumstances and the equipment internal mechanical factors. Therefore, the diagnosis of motor faults is an important task for engineers at an early stage and avoids maintenance cost.

A. Programming language:

In this study, Python and the Scikit-learn package were used to conduct the modelling and fault detection. Python is an interpreted, object-oriented, high-level programming language, often used for data analysis and scientific computing. Python contains a wide range of different packages that can be used for these tasks, the Scikit-learn package being one of them. Scikit-learn is one of the most used packages for machine learning and provides a range of ML algorithms, including algorithms for regression, clustering, dimensionality reduction and preprocessing of features.The programme which we have created will continuously get signals from the concerned motor which will monitor the health of the motor, and hence it is possible to identify the faults even while they are developing. The operator/technician can take preparation for the preventive maintenance and can arrange for necessary spare parts, in advance, for repairing.

B. Working of computer code to detect fault:

We used data available on the internet to detect different types of faults.We can detect faults in an induction motor by observing the current,voltage supply,supply frequency. By using input values such as current,the voltage computer can detect what type of fault will occur and does it require to immediately turn off the motor to avoid damage to other parts.If the motor already has fault then by getting current,voltage,etc values the computer can tell what type of fault is.

IV. CONCLUSION

This research paper presents early fault detection in induction motors using python(computer language)Python is an interpreted, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high level dynamic data types, and classes. It supports multiple programming paradigms beyond object-oriented programming, such as procedural and functional programming. Using available data of faults induction motor in python language we can detect fault in advance. Induction motors are the main workhorse of industrial prime movers due to their ruggedness, low cost, low maintenance, reasonably small size, reasonably high efficiency, and operating with an easily available power supply. About 50 % of the total generated power of a nation is consumed by these induction motors . This statistics gives an idea regarding the use of a huge number of induction motors, but they have some limitations in their operating conditions. If these conditions exceed then some premature failure may occur in the stator or/and rotor. This failure, in many applications in industry, may shut down, even, the entire industrial process resulting in loss of production time and money. Hence, it is an important issue to avoid any kind of failure of the induction motor. Operators and technicians of induction motors are under

continual pressure to prevent unscheduled downtime and also to reduce maintenance cost of motors.

V. SCOPE IN FUTURE

Expert systems can be employed for fault diagnosis using rules obtained from the connection weight of a supervised neural network and rules extracted from heuristic knowledge. This combination of Artificial Neural Networks and expert knowledge may enhance the monitoring system for diagnosis. Moreover, a database for vibration harmonics using experimental and theoretical investigations for various sizes and design standards of three phase induction motors can be created. Through this database, a new standard for vibration can be established instead of the traditional one, which depends upon RMS velocity of vibration rather than harmonic amplitude.

SCOPE IN AI:

Several Intelligent techniques like Fuzzy logic systems,Artificial Neural Networks, Neuro-Fuzzy Systems etc. have been elaborately discussed for induction motor condition monitoring. Usually, any Artificial Intelligence (AI) based diagnostic technique has three prime steps- i) Signature extraction ii) Fault detection and iii) Fault severity estimation. In, a schematic of Neural Networks for condition monitoring of an induction motor is presented.

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