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"Online Off-Site Condition Monitoring Of Three Phase Induction Motor by Using GSM Technology"

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***Abstract*— This paper describes online off-site condition monitoring of three phase induction motor by using GSM technology. In this approach, a microcontroller based hardware unit has been developed to continuously monitoring and measure the stator current of the motors. In a motor monitoring system the motor is connected with one microcontroller based hardware unit, which is also connected to Global System for Mobile Communication (GSM) modem. The preliminary level of fault or abnormality in operation of motor is diagnosed by the Fast Furrier Transform in MATLAB and the fault details are reported to the assigned operator through an SMS service. In extreme case, the provision of motor is shut down by a return SMS is also provided. A lab model is set up and is working satisfactorily.**

Keywords*— *GSM Modem, Moto Fault, Motor current Monitoring, SMS Service.

I. INTRODUCTION

Condition monitoring of induction motor have a challenging task for engineers in industries. There are many conditions monitoring methods including vibration monitoring, thermal monitoring, chemical monitoring all these monitoring methods required expensive sensors or specialized tools whereas online off-site condition monitoring of induction motor using GSM does not required additional sensors. This also contains AVR controller which generates controlled signals which is transmitted to server also makes use of mobile frequency band provides complete automation. It monitored stator fault, rotor fault, bearing fault by using microcontroller which communicates with GSM and GSM send message to the user. Condition monitoring of induction motor is a process that may be used to great advantage in agricultural field as well as in the industrial application. Motor current acts as an excellent transducer for detecting fault in the motor. Spectrum analysis of the motor's current and voltage signals can hence detect various faults without disturbing its operation. Current signature analysis involves the measurement of electric current around any one phase either through clamp on meters or through CT's. This current is then transformed into its frequency spectra and analyzed for detection of fault .

The proposed work for project aims is to detect the rotor fault by online off site condition monitoring of induction motor using GSM technology by developing working model of system.

II. INDUCTION MOTOR FAULT

Induction machine failure surveys have found the most common failure mechanisms in induction machines are stator related faults, rotor related faults, bearing related faults and other faults.

Stator fault: - Almost 38% of induction machine failures fall stator fault. The three phase stator winding consists of coils of insulated copper wire placed in stator slots. Stator winding faults are caused by insulation failure between two adjacent turns in a coil. This is called a turn-to-turn fault.

Rotor fault: - Rotor faults account about 10% of total induction machine failures. The failure mechanism is a breakage or cracking of the rotor bars which can be due to thermal or mechanical cycling of the rotor during operation. This type of fault creates the twice slip frequency sidebands in the stator current spectrum around the supply frequency signal.

Bearing fault: - Almost 40% of induction machine failures because of bearing fault. The majority of induction motor use ball or rolling elements bearings and these are one of the common causes of failure. Bearings consist of an inner and outer ring with a set of rolling elements placed in raceways rotating inside these rings. Faults in the inner raceway, outer raceway or rolling elements will produce unique frequency components in stator current signals

Other fault:-Almost 12% of induction motor fails because of other faults like eccentricity faults etc.

III. METHODOLOGY FOLLOWED

The proposed work aims is to detect the rotor fault by online off site condition monitoring of induction motor using GSM technology by developing working model of system. There are several techniques that can be used for detecting faults in induction motors.

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The MCSA (Motor Current Signal Analysis) is a non-invasive, on-line monitoring technique for diagnosing problems in induction motors. This method is based on the spectral decomposition of the steady state stator current which can be acquired with simple measurement equipment and under normal operation of the machine. MCSA can diagnose failures such as broken rotor bars, shorted turns, bearing damage and air gap eccentricity. In the MCSA method, the current frequency spectrum is obtained and specific frequency components are analyzed. These frequencies are related to well-known machine faults. Therefore, after processing the stator current, it is possible to infer about the machine's condition an accurate comprehension of the influence of each variable is desired for the correct interpretation of the data acquired.

In this work the frequency spectrum is obtained using the FFT. For the cases where the data acquisition is done for a complete number of cycles of the frequency component being studied, obtaining its amplitude and frequency is relatively straight forward. However, this is rarely the case, leading to cases where certain frequency components mask others of interest. This is commonly known as leakage. Another fact which must be taken into account is that the motor's load conditions are not always the same; this alters the fault signature characteristics as well. The main objective of the technique described in this paper, is to identify the frequency components associated with the types of failures previously mentioned, independently from the motors' operating conditions and data acquisition, and monitor them in order to determine the condition of the machine. To avoid the masking effect, the signal is multiplied by a function (also known as window) to reduce the discontinuity. Both the description of different windows and their results are not analyzed instead it focuses on the acquisition of the current's frequency components' amplitudes, of those components which are induced by each failure. When the number of samples is sufficiently high (tests have been done using sampling rates of 5 kHz, 2 kHz and 1 kHz during a sampling time of 8 s and 10 s), the values of the discrete Fourier series converge to those of the continuing Fourier series.

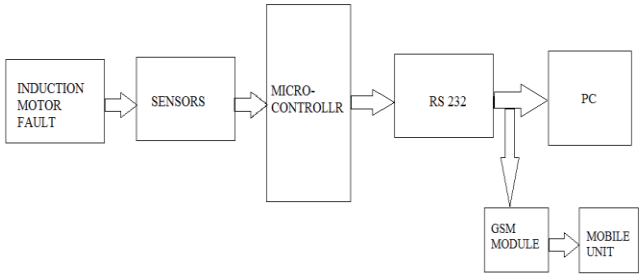

Fig1: Block diagram of general approach

Different type of sensor can be used to sense the characteristic signals resulting from fault.

Various signal processing techniques are applied to these sensor signals to extract particular fault. fig 1 shows block diagram of general approach. Current transformer will sense the current from one phase of stator winding which is given to microcontroller for analysis purpose then signal is given through RS 232 to the GSM module as well as computer where the fault is analyzed in MATLAB through FFT. This GSM modem is a highly flexible plug and easy integration to RS232. GSM modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. In most parts of the world, GSM modems are a cost effective solution for receiving SMS messages, because the sender is paying for the message delivery.

IV. System Description

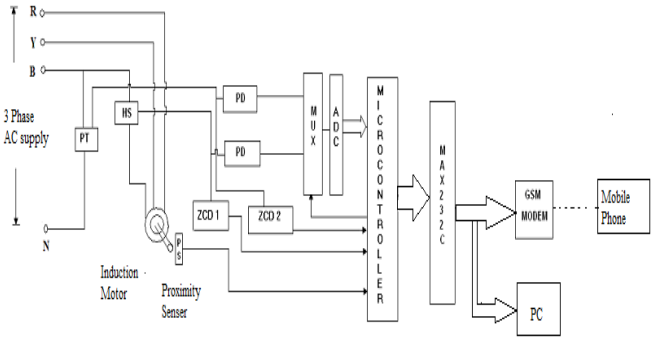

Fig 2: Schematic diagram of a Method

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The developed GSM based remote fault monitoring system consists of four main blocks viz. microcontroller based hardware unit, GSM modem, pc with MATLAB, mobile unit. Induction motor is associated with dedicated hardware unit for data acquisition to measure the stator current parameter the fault condition is detected by DHU and generate message and send to pre-assigned as a text SMS through the GSM modem. DHU passed same signal to computer through RS232, where the fault signal is analyzed by MATLAB.

DHU, the microcontroller is interfaced with, current transformer (CT) or hall sensor (HS), through proper hardware circuitry in order to measure the applied voltage, fault current and speed of the motor. The fault or abnormal conditions are also classified into different levels of priorities. Depending upon the priority of the type of abnormal conditions the DHU decides its corrective action. In case of highest priority abnormal conditions the machine will be isolated from supply.

V. Interfacing Of GSM Modem With DHU

A GSM modem is specialized type of modem, GSM accepts SIM card, and operate over a subscription to a mobile operator, like mobile phone from mobile operator perspective GSM modem tools like a mobile phone.GSM also pioneered low-cost implementation of the short message service (SMS), also called text messaging, which has since been supported on other mobile phone standard as well GSM modems are most frequently used for sending and receiving SMS message. A GSM modem exposes interface that allow application such as SMS to send and receive message over modem interface. During the process witch faults occur can be displayed on the screen of mobile with the help of communication done between microcontroller and GSM, because of TXD of microcontroller is connected to RXD of GSM and RXD of microcontroller is connected to TXD of GSM. To perform these tasks GSM modem must support extended AT command extended this AT command set for sending/receiving SMS message. GSM modem can be quick and efficient way to get started with SMS because special subscriptions to SMS service provider is not required. GSM modem is cost efficient solution for receiving SMS message because the sender is paying for the message.

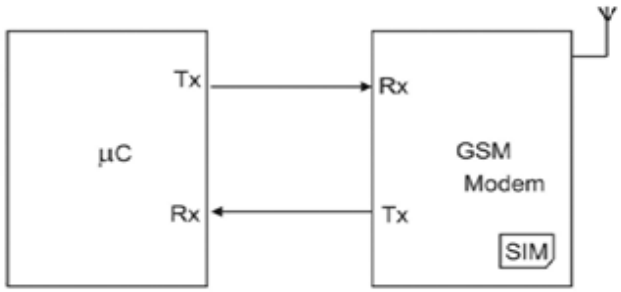

Fig 3: Schematic diagram of GSM interfacing

The GSM modem is built with a COM port with RS232 protocol based interfacing facility. First the microcontroller has to send "AT" command word. A response "ok" is returned from GSM modem. The microcontroller sends another query like by sending "AT+CPIN?" to get the PIN (Personal Identification Number).If the SIM card is ready the response "+CPIN: READY" is returned. After this, step by step AT commands are to be sent for the required SMS services.

VI. Conclusion

The approach discussed in the paper has achieved the target to remotely monitoring the three phase induction motor using the GSM based system satisfying user needs and requirements. GSM technology capable solution has proved to be controlled remotely, provide industrial security and has achieved the target to control different induction motor remotely using the SMS-based system satisfying user needs and requirements GSM technology capable solution has proved to be controlled remotely, provide industrial security and is cost-effective as compared to the previously existing systems. It have more advantages as compared to the other monitoring method .Here motor monitored through GSM modem from remote place as result manpower as well as time requirement will be less. This offers major benefit to both customer and companies in terms of efficiency, reliability, and cost saving and motor is fully protected. A methodology based on MCSA is presented for monitoring and diagnosing faults in induction motors. This method is able to ascertain the exact value of both magnitude and frequency of the signal's components, regardless of the sampling time. Therefore, studies of the faults' growth tendencies are very easier.

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