Web Based Remote Diagnostic Approach for Single Phase Induction Motor

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Abstract **- The main objective of this paper is to propose and implement effective architectural models for monitoring and making remote diagnostics of single-phase induction motor system in a completely secured, distributed, platform-independent and language-independent environment. Although significant progress has been made in this research area, still efficient distributed environment is not yet been attained. The Web-enabled architectural models are emerging as basic technology to support the integration of different applications using open Internet standard. An attempt is being made to convert existing architectural models into Web based model for monitoring and making remote diagnostics of single-phase induction motor system in distributed environment. An embedded controller is used to acquire the parameter of the system.**

Index Terms **- e-diagnostic, electrical drive, Web and data acquisition**

I.INTRODUCTION

As a result of the recent advent of distributed computing and Internet technologies has given way to monitor the system in distributed environment. Condition monitoring of induction motors is commonly used in industrial applications to maintain safe and reliable operation of plants. The current practice in condition monitoring primarily involves using various forms of mobile devices usually with a single sensor input to perform tests at regular intervals. However, such devices and monitoring services are expensive and require an experienced operator for reliable decisions. This paper investigates an alternative low-cost solution for continuous condition monitoring of induction machines using multiple sensors, which can be located next to a machine under test and can provide condition information using indicator lights for quick diagnosis (Bakhri et al.)
Bayindir and vadi proposed a novel remote monitoring and control system for induction motors using GPRS/GSM communication. Elavenil and Kalaivani presented the integration of embedded system with a ZigBee wireless sensor networks technology for the speed and torque monitoring of three phase induction motor. Meliones et al. developed a flexible modular network-based application which supports all key services for automatic remote control and management of photovoltaic parks.
Leite et al. has shown a laboratory set up for real-time analogue monitoring instrument developed for an integrated test bench for teaching as well as for R&D activities, in power electronics and variable speed drives of induction machines. The instrument is based on electronic modules and has been developed for monitoring the stator, rotor and magnetizing fluxes space phasors, electromagnetic torque as well as active and reactive powers.

1.1. Types of faults in Induction Motor

Any time a motor is operated beyond its design parameters, it is at risk of failure. Various faults that can occur in electrical drives are:

- Connections: welding, crimping, corrosion
- Bearing faults: affected by temperature, wear, loading, environment, improper lubrication, excessive vibration, and poor alignment.
- Insulation: due to temperature, overvoltage, initial manufacturing quality
- Rotor eccentricity: manufacturing, loading, wear.
- Rotor bar breakage in induction motors: manufacturing problems, starting cycles.
- Permanent magnet demagnetization: load, temperature, controller error, noise
- Gears & Sensor failure (e.g., rotor position sensor, current sensor).
- Power electronics components: switches, capacitors, gate drivers.

The following failure modes were identified during a study by the Electric Power Research Institute (EPRI) in1985:

41% of faults: bearings
37% of faults: stator
10% of faults: rotor
12%: other miscellaneous faults

II. ARCHITECTURE

A. Conventional Model

First, One-tier architecture has a huge advantage of its simplicity, since it does not need to handle any network protocols, so their code is simpler. Such code also benefits from being part of an independent operation. It does not need to guarantee synchronization with faraway data, nor does it need exception-handling routines to deal with network failure, bogus data from a server, or a server running different versions of a protocol or program. Figure 1 shows the conventional model for monitoring electrical drive system.

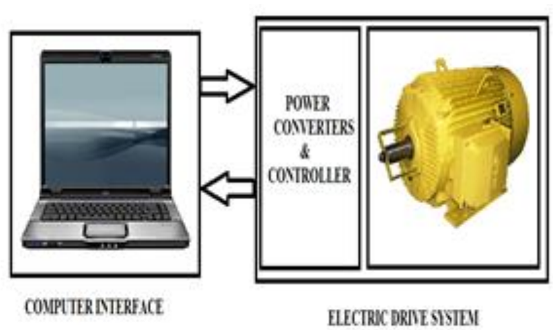

Fig. 1. Conventional Model

B. Web-Based model for monitoring induction motor

Web technologies enable communication between dissimilar computers over a large geographical region via Intranet or Internet. These provide a general distributed computing environment so that distributed applications can be implemented in it to exploit cheap but powerful parallel virtual machines. Web-based computing permits data sharing and computing over a large system range on heterogeneous hardware and software platforms, permitting the execution of number of operations simultaneously. The concept of Web sharing mode is shown in Figure 2. This technology is basically based on client-server paradigms and concurrent programming. The features of proposed architectural models are detailed as follows:

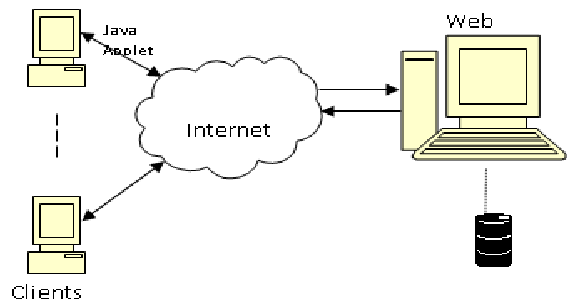

Fig. 2. Web-based share computing model

- In RMI mechanism, the client can communicate with server only if the stub is present and the availability of stub should be taken care by the developer. But in the case of Web service, automatically it takes care the availability of stub.
- Java RMI use optimized connection-oriented communications protocols that are either language specific or have detailed rules defining how data-structure and interfaces should be realized. In contrast, Web services are based on the ubiquitous technologies that have grown up to support WWW-services (human-via-browser-to-application).
- There is no concept of an object reference; instead, a service is defined by an endpoint that supports various operations.
- Web services provide interoperability between various software applications running on disparate platforms.
- Web services use open standards and protocols. Protocols and data formats are text-based where possible, making it easy for developers to comprehend.
- By utilizing HTTP, Web services can work through many common firewall security measures without requiring changes to the firewall filtering rules. Other forms of RPC may more often be blocked.
- Web services allow software and services from different companies and locations to be combined easily to provide an integrated service.
- Web services allow the reuse of services and components within an infrastructure.
- Web services are loosely coupled thereby facilitating a distributed approach to application integration.

III. PERVASIVE COMPUTING

Since both SOAP and WSDL are XML-based, XML messages have to be parsed on both the sides. The client-side proxies have to be generated on the client side before any communication can take place. XML parsing at runtime requires additional processing time which may result in longer response time of the server in case of a Web service server. The overhead of the Web service stems mainly from the usage of XML producing human readable text and is employed when interoperability with other Web services and applications is essential (Caincarini et al 1999). Even though Web services suffer from poor performance compared to other distributed computing approaches such as RMI and CORBA, the Web enabled model provides a cross-platform, cross-language data model that facilitates developing heterogeneous distributed applications. XML-RPC is found a useful way to tie together the systems written in different languages on different operating systems and enabling them to co-operate. The real advantage is that the structure of XML-RPC is flexible enough to be put to different engineering applications.

A. Pervasive Computingfor monitoring induction motor

Pervasive computing can be defined as “The overall infrastructural support needed to provide proactively a rich set of computing capabilities and services to a user every time everywhere in a transparent, integrated and convenient way.” Pervasive computing also called ubiquitous computing, the growing idea towards embedding microprocessors in everyday objects so they imbedded with chips to connect the device to an infinite network of other devices. The idea that technology is moving beyond the personal computer to everyday devices with embedded technology and connectivity as computing devices become progressively smaller and more powerful.

Pervasive computing is about four things: users, applications, middlewares and networks. In between Personal and pervasive computing there are three more evolutionary steps namely distributed, web and mobile computing. For successful implementation of pervasive computing, protocol layering, packet switching, information caching, distributed file and database systems and encryption systems are also needed in pervasive computing. Pervasive computing defines a major paradigm shift from “anytime anywhere” computing to “all-time everywhere” computing.

The technological advances that are needed to build a pervasive computing environment can be framed into four broad areas: devices, networking, middleware and applications.

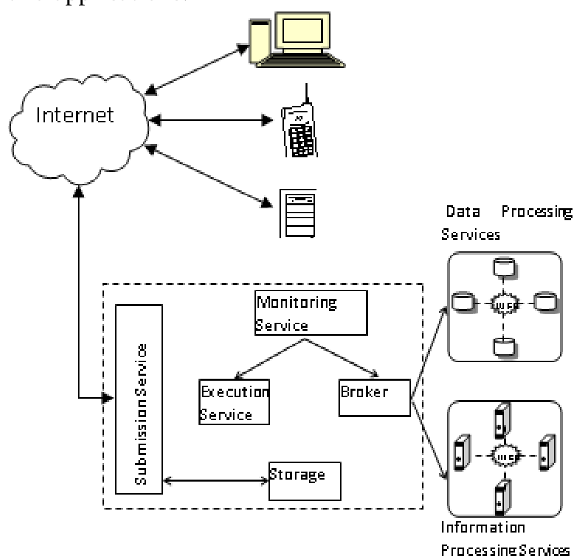

Fig. 3. Pervasive computing for monitoring electrical drive system

New intelligent devices called smart devices are embedded with microprocessors that allow users to plug into intelligent networks and gain direct, simple and secure access to both relevant information and services. In case of mobiComp, distributed Computing, a shell of middleware is essential to interface between them and pervasive network and end-user applications running on pervasive devices. Some of the functionalities of pervasive middleware are smartness, context-awareness, proactivity, transparency, mobility management, invisible interface, and adaptability.

IV.HARDWARE SETUP

The hardware design of the remote monitoring system consists of a microcontroller DSPIC-4011, a three-phase induction motor, sensors, PC and interface cables. The hardware setup is shown in Fig.4. The 3Φ induction motor (Siemens Make) with specifications of 0.5hp, 1.05A, power factor of 0.74, frequency 50 Hz, Voltage 415V and efficiency of 66% is used for diagnostics. This is connected to a PC using RS-232 connector. Proximity sensors and vibration meter are connected to the microcontroller. Various parameters:

voltage, current, speed and vibration are monitored for the healthy motor. Using the same experimental setup, fault diagnostics is done under single phase and short circuit conditions and the parameters measured for the faulty motor are compared with healthy motor. Experimental results show that with reference to normal condition, vibration increases in a single-phase condition and decreases in a short circuit condition. Speed increases and Current decreases in both conditions.

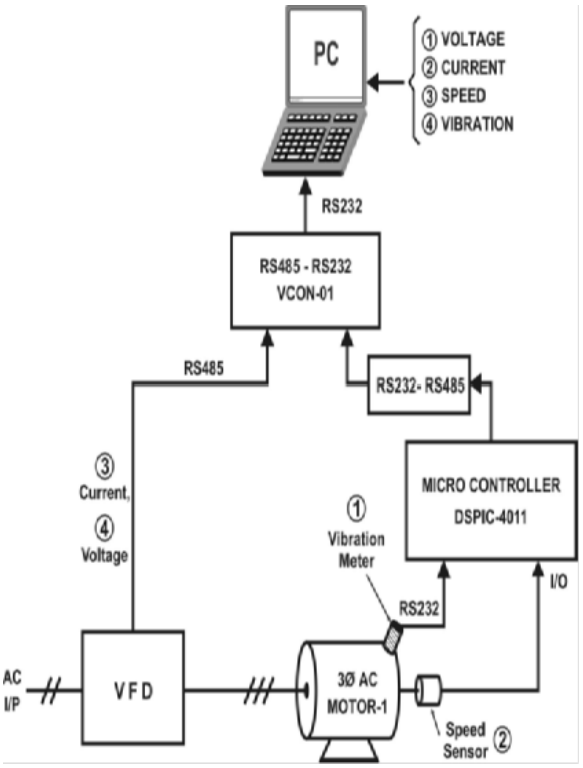

Fig.4. Schematic Diagram for Fault Diagnostics of Induction Motor

V.WEB PAGE OF INDUCTION MOTOR MODULE

The induction motor module has been designed to give information about the specifications, experimental setup, hardware setup etc. It contains a real time monitoring module which monitors the induction motor and displays its status. This module lists the condition of the induction motor at various states. Figure 5. shows the home screen of induction motor module.

On clicking various options including monitoring setup, full comparison of three phase induction motor etc. as shown in Figure 5.18, respective link will be opened, and corresponding web page is displayed.

Fig 5. Home screen of induction motor module

VI.CONCLUSION AND FUTURE WORK

This study has a remarkable and significant importance for the reason that it can be used in monitoring, controlling and determination of system cases where the places are distant from the residential areas and have no access to the Internet. Moreover, it can be used as a training tool in professional and technical education. Using this framework induction motor is monitored through internet. Future extensions of the presented work will study more novel approaches for monitoring the electrical drives on Wireless Sensor Networks (WSN) technology and through mobile phones.

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