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LABVIEW Based Real Time Parameter Monitoring system for Single Phase Induction Motor

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ABSTRACT - The uses of electric machines are vital today. These are major equipments for engineering, industries, and research scholars as well as in day to day life. In today's technological advanced and computer based environment use of these machines are limited until they are not upgraded. Thus automation and up gradation are very much required. Here in this paper we are presenting a not much expensive and more accurate method for automation of electric machines.

General Terms - Electrical Machines, Instrumentation, Control Systems.

Keywords - Automation, Data Acquisition System, LabVIEW, Single Phase Induction motor (SPIM), Sensors, Virtual Instrumentation

I. Introduction

As being a mandatory part of engineering studies and one of the core subjects of electrical engineering, Electrical Machines (such as Transformers, AC and DC Motors, Generators, etc.) Course consists the concepts theoretically as well as practically.

The view point and perception of the society towards the electrical machines is need to be changed by modernization and computerization. It is mentioned and observed in a paper by Nehrir, Fatehi and Gerez [9] that why less students are taking this for further course study. The greatest challenge today is to make Theoretical knowledge compatible enough to be used digitally for this purpose simulation of electrical machines are mandatory and computer added tools are required is laboratory.

Involvement of digital technologies and computer added tools in the industries and laboratory courses of universities has been mentioned in the literature[4,5,6,7,8,10,11,12], Krein and Sauer [10] at the university of Illinois at Urbana-Champaign, Mohammed and Gorden [14] at Florida International University and Krishna Vasudevan from Indian Institute of Technology, Madras have proposed techniques for modernization and automation of machines. But some of these process and techniques require high capital investment, which is not always affordable to majority of engineering universities industries to incorporate. The main reasons to hesitate to work with electric machines are high voltages and live terminals which are very risky for the students and operators working in the environment.

In today's era many devices are developed which can transform from analog to digital. These devices results in more accurate and precise measurement. For the purpose to acquire machine parameters, an in-house data acquisition module (DAQ) has been developed. It can sense & measure the following parameters of the machine, like armature and field current, voltage, speed of the machine set and the rise in temperature of the machine. The method proposed here maintains the isolation of person working in the machine environment, and thus ensures safety of the operating personnel.

Here In this paper a methodology has been proposed to design and develop a low cost solution for automation in Electrical Machines.

II. SYSTEM ARCHITECTURE

We have chosen single phase induction motor as test machine for our initial setup. Other hardware components are Data Acquisition Card (DAQ), PM 2110 power meter, proximity sensor and USB RS 485/422 converter. The software involves the National Instrument's LABVIEW 8.5[9]. This virtual instrument is used for purpose of programming of the system architecture. The block diagram of the system is shown in fig 1. The DAQ is built on the Atmega 328 microcontroller, which has a 10 bit, 6 channels Analog to Digital Converter (ADC). The VI communicates with the DAQ to acquire the data and displays it. It shows system result and displays the graph in front panel window in virtual Instrumentation.

The parameters to be measured during the testing are armature and field current, the field and armature voltage, the speed of motor.

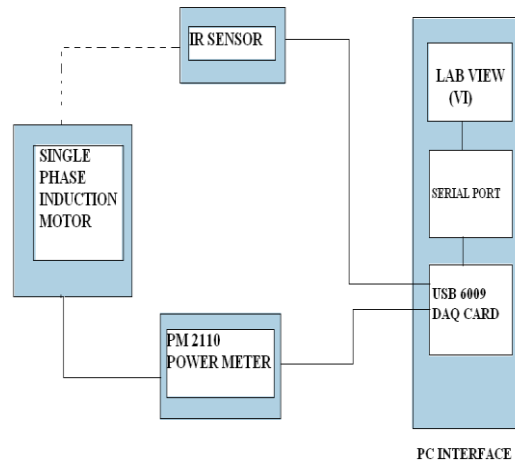


Figure 1- System Architecture

A. Data Acquisition Module (DAQ)

The NI USB-6008 and USB-6009 include a ready-to-run data logger application that acquires and logs up to eight channels of analog data. For more functionality, NI-DAQ mx Base software is a multiplatform driver with a subset of the NI-DAQ mx programming interface. Use it to develop customized DAQ applications with NI LabVIEW or C-based development environment. The Data Acquisition Module (DAQ) is based on the Atmel's micro-controller, Atmega328. And acts as an external USB Instrument, and uses the predefined LabVIEW(VI) protocols to communicate. The micro-controller communicates at 115200 bits per second with 8 data bits. It communicates with the computer via the USB port and USB RS 485/422 converter. It converts the USB signals to serial TTL so that the micro-controller can read. It acts as a virtual COM port. The diagram of DAQ module is shown in fig 2.



Figure 2 - USB 6009 DAQ card

B. PM 2110 Power Meter

The 2110 Power Meter is a solid state single phase power meter which accurately measures all quantities of supply including all types of energy. The 2110 Power meter is based on ASIC and micro controller, with a high degree of programmability. The meter has been programmed to operate as an intelligent front end measuring and storing device and to communicate continuously. All the data relevant for the purpose of SCADA, through isolated RS-485 port using MODBUS-RTU protocol. The meter is normally supplied readily pre programmed for operation and can be directly installed.



Figure 3 - PM 2110 Power Meter

C. Proximity sensor

The proximity infrared sensor is a reflective sensor that includes an infrared emitter and pin photodiode in a surface mount package which blocks visible light. These sensors integrate an infrared emitter and photo detector in a single package. The most common types of optical sensors are transmissive and reflective sensors. A

reflective sensor that includes an infrared emitter and phototransistor in a leaded package which blocks visible light.



Figure 4 - Proximity Sensor

The emitted light from sensor is reflected back towards the photo detector, the amount of light energy reaching the detector increases. This change in light energy or photo current is similarly used as an input signal in the application. The data of proximity infrared sensor are read by the USB 6009 DAQ card.

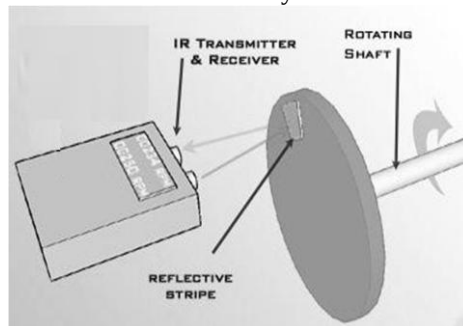


Figure 5 - Used Sensor Methodology

D. USB RS 485/422

The RS 485/422 is a USB (Universal Serial Bus) port to 2 or 4 wire isolated RS-485/422 converter. This converter requires no PCI/ISA slots or IRQs. Simply plug the converter into an available USB port on your computer or hub. Windows will configure the converter as an additional COM port, compatible with your Windows applications. The serial port side can be set up for an RS-422 or RS-485 network. A pair of LEDs shows when RS-485/422 data is being received or transmitted. The USB side permits quick setup. Just plug in the USOTL4 and Windows will install the drivers and set up the converter. USB bus supplies power so no separate power supply is needed. No special software is required to control the RS-485 receiver or transmit line driver. The driver is automatically enabled during each byte transmitted in RS-485 mode. The transmitter is always enabled in RS-422 mode. The receiver is tri-stated during each byte transmitted in the echo-off mode. The receiver is always enabled in the echo-on mode. There are 4.7k Ohm 1-up/pull-down resistors on the RDA and RDB lines. A termination resistor may be added to R16 if needed. See B&B's RS-422/RS-485 Application Note (available on our website or by mail) for more information on termination and DC biasing of an RS-485 network.

E. Lab VIEW

A Virtual Instrument has been developed in LabVIEW 8.5. This developed virtual instrument acquires data from National Instrument's Data Acquisition Card (DAQ card). It queries the DAQ for data and motor parameters and further communicates with the devices. The Block Diagram of the VI is shown in figure below.

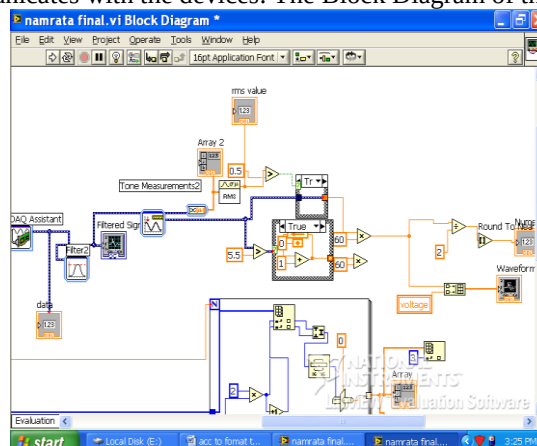


Figure 6 - Lab VIEW Block Diagram Panel

The Virtual Instrument displays the rpm of the motor and its efficiency. It also displays the field current, armature current and voltages (2 channels for each).

III. RESULTS & ANALYSIS

Project Hardware has been developed. It consists DAQ Card to communicate with LabVIEW, Power meter PM 2110, Proximity Sensor to sense the restriction in its path and detects the rpm of motor and a USB RS 485/422 converter for ADC making communication possible in setup. Input Terminals are provided with easy removal or replacement of the wires from the SPIM motor set. The complete hardware has been placed on a wooden plank and instantaneous readings can be taken from power meter display. The developed module shown in figure 6. The module has been fully calibrated and tested. It has shown a very low error rate (<1%) as measured against a standard tachometer.

IV. CONCLUSIONS

This paper presents an accurate, precise and cost effective method for the automation of electrical machines. It introduces digital measurement and computer-aided tools for the testing of electrical machines. With the developed system, more precise and accurate testing can be performed. The resulted data can be used for analysis or further research. Any individual can work freely without the risk of electric shock by using this technique. Thus this method can be used for research work and in industries extensively.

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