FAULT CONDITION MONITORING BY USING LABVIEW

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Bachelor of Electrical Engineering

May 2010

I declare that this report entitle "Fault Condition Monitoring By Using LabVIEW" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Fault Condition Monitoring By Using LabVIEW

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A report submitted in partial fulfillment of the requirements for the degree Of Bachelor In Electrical Engineering (Industry Power)

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)."

Signature : ....

Supervisor's Name : EN. MOHD HENDRA BIN HAIRI

Date : ....6/5/10..

Special dedicated to my beloved parent and family

For my supervisor, Mr. Mohd.Hendra Bin Hairi
Universiti Teknikal Malaysia Melaka

And lastly to my beloved friends and who encouraged, guided and inspired me throughout my journey in education

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Last but not least, I take this opportunity to dedicate this thesis for all electrical engineering students. All suggestions for further improvement of this thesis are welcome and will be gratefully acknowledged.

ABSTRACT

In real time power system monitoring, SCADA system is widely applied on power distribution side. The current available SCADA system is complicated and not economical to apply on industrial level especially factories. Industrial factories need a power monitoring system like SCADA to monitor fault condition on their places. The purpose of this project is to develop a monitoring system which can apply on industry side. This monitoring system is developed by using virtual instrument, LabVIEW on computer to monitor and record the fault data during fault in power system operation and the DAQ card is used to connect between power system and computer to acquire the real time data and convert it from analog to digital signal which able interpreted in computer. The system not only able to monitor and record fault condition ,but it also able to monitor the voltage, current and active power reading during power system operated through the interface of virtual instrument in LabVIEW. The result of this project is develops a monitoring system which can widely apply on industrial factories.

ABSTRAK

Dalam sistem masa nyata pemantuan kuasa, sistem SCADA ini telah diaplikasikan secara meluas pada sistem penagihan kuasa. Sistem SCADA ini yang terdapat di pasaran sekarang agak rumit dan mahal jika diaplikasikan di industri kecil. Industri ini memerlukan sesuatu sistem yang sama fungsinya dengan SCADA bagi memantau kegagalan pada sistem kuasa mereka. Tujuan projek ini adalah membangunkan satu sistem pemantuan yang dapat diaplikasikan di sektor industri. Sistem pemantuan menggunakan "Virtual Instrument", LabVIEW dibangunkan dalam komputer untuk mengawas dan merekod maklumat-maklumat penting semasa berlakunya kegagalan. Peranti DAQ digunakan sebagai antara muka sistem kuasa dengan kmputer. Fungsi peranti DAQ ini adalah menukarkan isyarat analog kepada isyarat digital yang dapat ditaksirkan oleh komputer. Sistem ini bukan sahaja dapat merekod maklumat kegagalan semasa kegagalan berlaku tetapi ianya juga dapat mempaparkan maklumat-maklumat seperti voltan, arus dan kuasa semasa sistem kuasa itu. Keluaran project ini, satu sistem pemantaun yang dapat gunakan pada sektor perindustian kecil.

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LIST OF ABBREVIATIONS

IEEE	-	Institute Electrical and Electronic Engineers
DAQ	-	Data Acquisition
VI	-	Virtual Instrument
PCMCIA	-	Personal Computer Memory Card International Association
USB	-	Universal Serial Bus
RSE	-	Reference Single-Ended Measurement System
ADC	-	Analog and Digital Conversion
RL	-	Resistor and Inductance
KVL	-	Kichoff's Voltage Law
AC	-	Alternating Current
DC	-	Direct Current
AI	-	Artificial Intelligent
SCADA	-	Supervisory Control and Data Acquisition
PEDA	-	Protection Engineering Diagnostic Agents
TNB	-	Tenaga Nasional Berhad
NRSE	-	Nonreference Single Ended Measurement System
RCCB	-	Residue Current Circuit Breaker
MCB	-	Miniature Circuit Breaker
Amp	-	Ampere
RMS	-	Root Mean Square

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CHAPTER 1

INTRODUCTION

1.1 Background and Problem Statement

In real time power system monitoring, the supervisory control and data acquisition (SCADA), Digital Fault Recorder, microprocessor-based protection relay with fault recording capabilities, travelling-wave fault locator and circuit breaker condition monitoring system is the whole protection system which apply in the substation and complex transmission line. From the system above, information collect from these protection system can aid the utility engineer to assess their protection system which is able to protect the power system. But sometimes the raw data collect from the system is uninformative [12].

Besides that, there are many working parts involve in SCADA system. Usually a SCADA system is included signal hardware (input and output), controllers, networks, user interface (HMI), communications equipment and software. All together, the term SCADA refers to the entire central system. This is too complicated and not economical to install on industrial.

Digital Fault Recorder which was widely apply on substation nowadays since it functioned as a recorder capture the waveform during fault but without a monitoring function during normal condition. It is big and costing system which is not suitable applies on industrial to protect their power system.

Therefore, in this project, we are going to develop a new system which can accurately and precisely monitor and recording the fault condition of power system which could widely apply on industrial to protect their power system will be developed.

1.2 Project Objective

Based on the problem statement discussed above, the objectives of this project are:

1. To develop a monitoring system to monitor real time fault condition.
2. To develop a system which able to record and store data when fault occur.
3. To analysis the system performances by using fault circuit modeling.

1.3 Project Scope

This project is to design a new monitoring system which able to continuously monitor voltage, current, and average power in normal condition. But during fault, system will automatically save and record the important reading and data to the computer. The proposed of this project is to protect the power system on industrial.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is executed to understand more about the concept and the designation of fault condition monitoring system during fault. Besides that, several references such as from IEEE journals and from other book is required to find, get, collect and analyze information that related with the project. Knowledge of LabVIEW, DAQ system and fault condition in the power system will be discussed at here.

2.2 LabVIEW

National Instrument invented virtual instrumentation software platform - LabVIEW also known as Laboratory Virtual Instrumentation Engineering Workbench [1]. It is a powerful and flexible graphical development environment which departs from the sequence of traditional programming language. With its graphical programming language, sometimes called "G" programming language, you can program using a graphical block diagram is the source code which could compiles into machine code [2]. The art of successful programming in G is an exercise in modular programming. By using this graphical programming language, we eliminate a lot of the syntactical detail associated with text based languages such as put a semicolon and curly braces. LabVIEW is working based on the dataflow principle, which in mean function only will execute when necessary data is received [2]. Engineers and scientists in research, development, production, and test and service industries like aerospace, electronics, seminconductor and automomotive have used the LabVIEW to support their work.

LabVIEW programs are called virtual instrument, in short known as Vis which can used for signal acquisition, measure analysis, and data presentation.. As mention earlier, it is a graphical programming which creates programming relying on graphical symbols to describe programming actions. Hence, it is easy to use and command compare to syntax programming like C++ and JAVA.

2.2.1 LabVIEW Environment

Virtual instrument LabVIEW is work together under three main parts – the front panel, block diagram and icon/connector. By using these three main components, we able build a program which able to monitor performance of power system during normal condition and fault condition and record during fault. Below will be explained in detail about these three main parts:

a.) Front Panel

Front panel is the window through which user interact with the program. When you start running the VI, you need the front panel for input and control your data from keyboard or mouse and show the result through various indicator from the LabVIEW.
In the front panel, it equips with control instrument like knob, push button and other control device and indicator like graph and LED. Figure 2.1 shows example of the front panel:

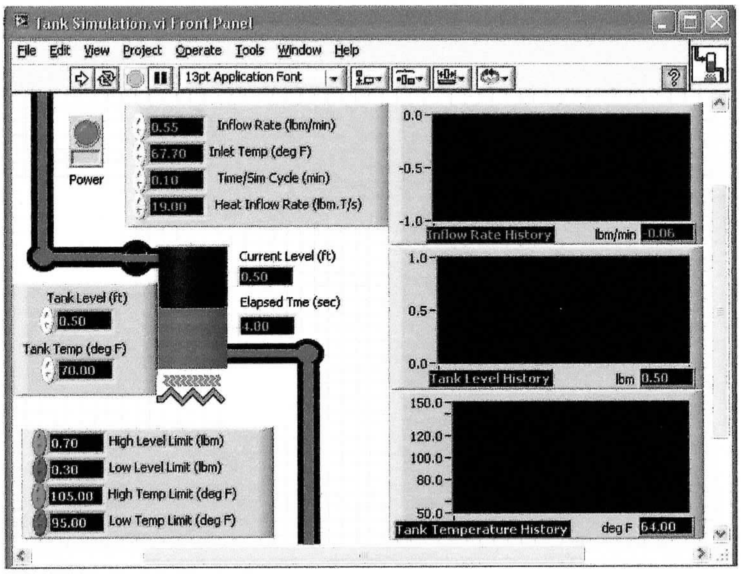

Figure 2.1: LabVIEW Front Panel

b.) Block Diagram

The block diagram window holds the graphical source code of LabVIEW VIs. LabVIEW's block diagram corresponds to the lines of text found in a more conventional language like C or JAVA – it is the actual executable program. The components of block diagram are low-level Vis, built-in functions, constants and the program execution control structures [2]. Figure 2.3 is example of block diagram:

c.) Icon/Connecter

Jeffrey Travis and Jim Kring (2007) states that 'icon is VI's pictorial representation and is used as an object in the block diagram of another VI. A VI's connector is the mechanism used to wire data into the VI from other block diagrams when the VI is used as subVI' [2].

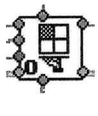

Figure 2.2: Icon and Connector

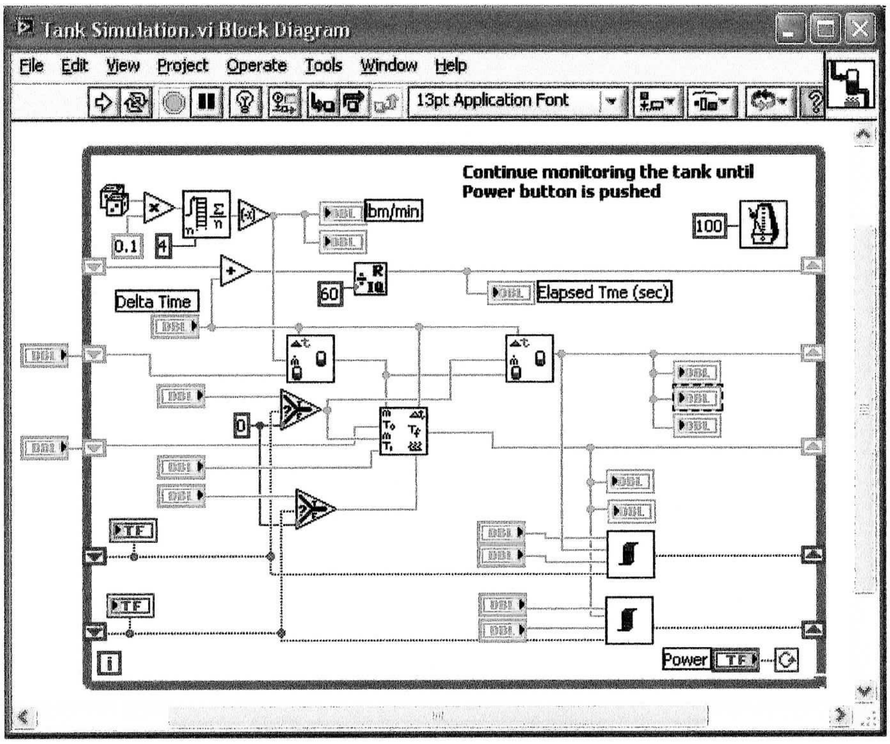

Figure 2.3: A VI Block Diagram

2.3 DAQ System

Jeffrey Travis and Jim Kring (2007) state "Data acquisition, or DAQ for short, is simply the process of measuring a real-world signal, such as a voltage, and bringing that information into the computer for processing, analysis, storage, or other data manipulation."[2] We are trying to measure the real world signal such as speed, temperature, humidity, pressure, flow, pH, voltage and current and bringing these signals for further more analysis. Transducer and sensors are used to "evaluate the physical and produced electrical signal as proportionately" according to Jeffrey Travis and Jim Kring (2007). Concept of data acquisition will further more discuss in below.

2.3.1 Component for DAQ

For a complete DAQ system, transducer, signal conditioning and suite software is needed to acquire data, analysis, display to user and store the data. There are two options to setup the DAQ system. Option A, by using the PCMCIA slot in the computer; insert a DAQ device into the port. Option B, using the USB type plug-in DAQ device connect to your laptop or desktop and run with LabVIEW since it equip with various manufacturing DAQ card driver. Option B is more convenient compare to option A. As mention above, virtual instrument can measure a physical signal but it need a sensor to convert this physical signal into an electrical signal [3]. Since most of DAQ card can only withstand low range voltage like National Instrument NI-USB 6009 DAQ card analog input voltage only withstand 10V, so we need signal condition accessory conditions measured signal before plug in to DAQ device.

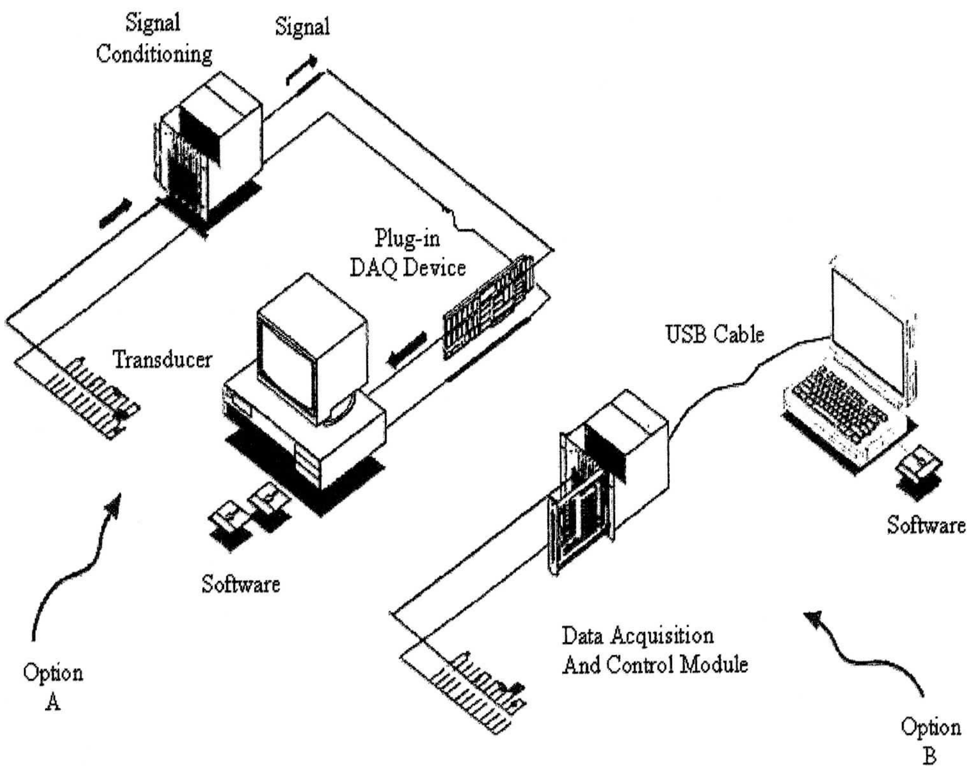

Figure 2.4: The Hardware Architecture

2.3.2 Type of Signal

Five common classes of information can be extracting from a signal. There are state, rate, level, shape and frequency content. Signal always evolve around continuously or only at discrete time. For data acquisition, signal can be classified as below [3]:

Digital Signal

i.) On-off

ii.) Pulse Train

Analog Signal

i.) DC-Static or Show Changing Signals

ii.) AC-Fast Changing Signals

iii.) Frequency-Domain-Frequency analysis of AC and DC Signals.

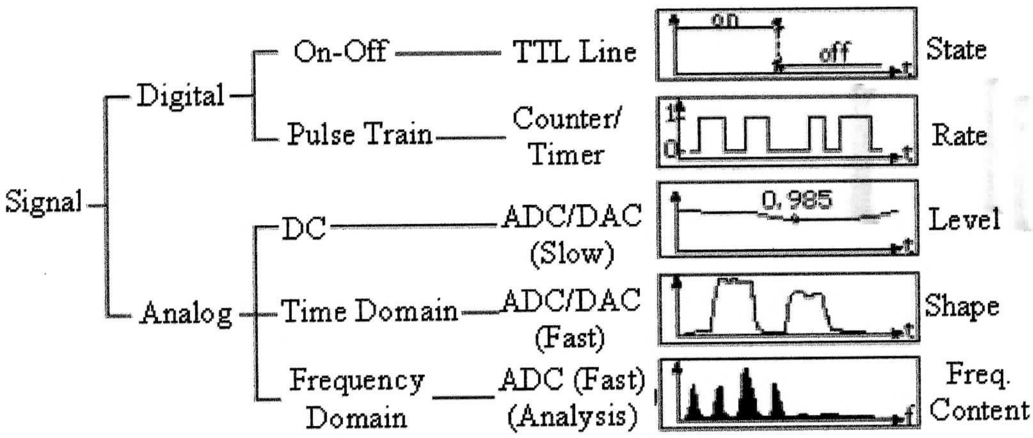

Figure 2.5: Type of Signal

A digital signal has only two possible states: high level (on) or low level (off) but for analog signal contain information that varies continuously with time [3].

2.3.3 Analog to Digital Conversion (ADC)

For choosing a DAQ device, there are four parameter is needed to be consider in order to obtain a quality of the analog to digital conversion. The four parameters that are concern are:

1.) Resolution
2.) Device Range
3.) Signal input range
4.) Sampling rate

Depending on type of DAQ device is used, either these four parameters are set on the hardware or we set by using software (setting in LabVIEW).

ADC resolution is represent by the number of bit used [2]. We compare the resolution of DAQ device by using the ruler; fixed a ruler length, the more division in fixed ruler length, and the more precise the measurements can be made. If the DAQ device has higher resolution, that mean DAQ device has a higher the number of divisions of the ADC range and, therefore, the more accurately the analog signal can be represented. Example when we are using 3 bit of ADC divide the signal in 2^3 divisions ($2^3 = 8$), which each division represent by a binary or digital code between 000 and 111. Diagram show the different between 16 bit and 3 bit ADC resolution. From the diagram below, we will found that 16-bit resolution have the higher accurate than 3-bit solution since sinusoidal waveform capture by using 3 bit resolution already distorts.

Device range which is refers to the minimum and maximum analog signal level that ADC can be handled [3]. We should attempt to match the range to that of the analog input signal to take best advantage if the available resolution [3]. Example, for Figure 2.13(a), we setting that 0 to 10V range, by using 3 bit solution, the smallest detectable voltage is 1.25V. For figure 2.13(b), we setting the range from -10V to +10V, ADC now is separately a 20-volt into eight divisions. Hence, the detectable voltage is 2.50V. The accuracy to represent the signal is dropped.