IDENTIFICATION OF POWER QUALITY DISTURBANCES

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BEKE

2009

"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 (Power Electronics and Drives)"

Signature : ....

Supervisor's Name : AHMAD SOIL B ABDUL RAHMAN

Date : 12/5/09

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This Report is Submitted In Partial Fulfillment Of Requirements For The Degree of Bachelors In Electrical Engineering (Power Electronics and Drives)

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MAY 2009

I declare that this report entitle "*title of the project*" 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.

Signature : ....

Name : SITI NOR HANIZAH SUARIFF MOHD FUAD

Date : 12 MAY 2009

For my beloved parent, Syariff, M.F. and Abdullah, S.N.A
Appreciation for their supports and understanding.

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ABSTRACT

Power quality monitors are increasingly being used to assist electric utilities in the evaluation of the present attributes of electric power so that quality improvement actions can be taken. This fact highlights the need for a new classification strategy which is capable of tracking, detecting, and classifying power-quality events. The increased amount of recorded data requires more sophisticated analysis method. In this paper, a new classification approach that is based on the threshold method is proposed and two types of disturbances only can be implemented for detection and classifying; voltage sag and swell. The data tested is the actual data from TNB transmission lines and the disturbances divided into sag, swell and combination both.

ABSTRAK

Pengawasan kualiti kuasa adalah semakin meningkat disebabkan oleh faktor untuk menilai kuasa elektrik yang digunakan pada masa ini supaya kualiti kuasa elektrik dapat dipertingkatkan dengan pelbagai langkah berkesan boleh diambil. Fakta ini juga mempertingkatkan perhatian pengguna tentang keperluan dan strategi untuk memerhati, mengesan dan mengkategorikan gangguan kualiti kuasa. Peningkatan jumlah pengrekodan data yang semakin banyak juga memerlukan satu cara analisis yang berkesan. Di dalam projek ini juga, satu cara pendekatan baru diperkenalkan untuk pengkelasan gangguan kuasa seperti kaedah sempadan. Dalam kertas ini juga, kaedah sempadan yang digunakan hanya untuk mengesan dan mengkategorikan gangguan jenis kelebihan dan kelenturan voltan. Data yang digunakan semasa proses ujian adalah data talian penghantaran TNB yang sebenar.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND SYMBOLS

ANSI	American National Standard Institute
CBEMA	Computer and Business Equipment Manufacturers Association
DFT	Discrete Fourier Transform
DTW	Dynamic Time Warping
ERPI	Electric Power Research Institute
FFT	Fast Fourier Transform
FM	Fast Match
FYP	Final Year Project
GUI	Graphical User Interface
IEEE	Institute of Electrical and Electronics Engineers
MATLAB	Mathematics Laboratory
PQ	Power Quality
RBFNN	Radial Basis Function Neural Network
RMS	Root Means Square
TFR	Time Frequency Representation
THD	Total Harmonic Distortion
TNB	Tenaga Nasional Berhad
UQ	University of Queensland
VQ	Vector Quantization
3D	3 Dimension

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of project

Power quality is a term used to describe electric power that motivates an electrical load and the load's ability to function properly with that electric power. Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power.

Electric power quality is an important issue in power systems nowadays .The demand for clean power has been increasing in the past several years. The reason is mainly due to the increased use of electronics components in various types of equipments such as computer terminals, programmable logic controllers and diagnostic systems. Most of these systems are quite susceptible to disturbances in the supply voltage.

Then, the power-quality study has become an important subject in recent years. In order to improve the quality of power, power-quality phenomena are usually investigated directly from actual recorded disturbance waveforms. Since the existing methods to analyze and identify power disturbances are primarily based on visual inspection of the disturbance waveforms, the power-quality engineer's knowledge plays a critical role, and many times, the power-quality engineer is overwhelmed with an enormous amount of data to inspect. Thus, it is desirable to develop automatic methods for detecting, identifying, and analyzing various disturbances.

New and powerful tools for the analysis and classification of power-quality disturbance are currently available, and the automatic classification of power-quality disturbances has made magnificent progress thus far.

To avoid this, the disturbances need to be first categorized so that relevant mitigation steps can be taken. A technique based on threshold method is used to categorize power quality events is described in this project. The project describes also a software structure.

1.2 Problem Statement

Demand for clean power has been increasing; there have been changes in a nature of electrical loads. On the other hand, the characteristics of load have become more complex due to the increased of power electronic equipment, which results in a deviation of voltage and current from its sinusoidal waveform. On another hand, equipments have become more sensitive to power quality due to its electronic nature.

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The impacts of various disturbances can be investigated and can reduce maintenance and repair cost for electrical and electronic equipments thus increases the productivity of industrial customers and their competitiveness in the global economy.

1.3 Objectives

Objectives of this project are:-

1. To study the fundamental of power quality including the definition, terminology, causes and the effects of the power quality events.

2. To design a system for power quality disturbances identification using threshold method.

3. To develop the classifier program using MATLAB.

4. To test the effectiveness of the program with the power quality data. Some are the sample data getting from Tenaga Nasional Berhad (TNB).

1.4 Scope of Project

The project scope for this system is applicable in voltage sag and voltage swells. The software MATLAB is the software that use in this project.

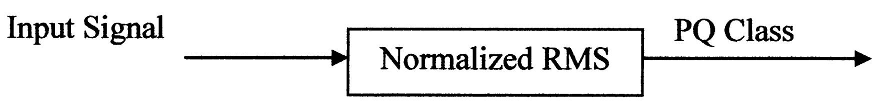

Figure 1.5: Proposed automated power quality events in identifying and classifying system.

In this proposed method, we have only one stage to complete up the objectives: normalized.

In early stage, the normal signals and signals that have disturbance (sag and swell) are generated using the formula and the actual data (TNB) also used for the results and analyzing. While, in normalized the actual signal is convert to the normal in amplitude of 1 to ease the classifying type of disturbances.

Then, continue with the threshold method. In this part, the data or signal input is comparing with the threshold boundaries that have been set in the program as the reference voltage. After that, the signal can be detected and classified the type of disturbances based on the threshold rule.

In this project, we limited the type of disturbances for analysis:

i. Voltage sag
ii. Voltage swell

1.5 Report Outline

In this final report there are seven chapters altogether. Chapter 1 gives some introduction, objectives and scope of this project. Literature review of this project is included in chapter 2. This chapter reviews the related work that been done by other people as well as the existing project. Chapter 3 reveals the methodology of completing this project.

Results and discussions are described in Chapter 4 which includes the programming and the software that used in this system.

It is the main part of this report. It has 2 main sections, which are:

i. Designing
ii. Calculation
iii. Testing(unknown signal/actual data) and analyzing

Chapter 5 furthers the discussion, problems related, conclusion and recommendations for the project.

CHAPTER 2

LITERATURE REVIEW

2.0 Literature Review

This subtopic reviews some previous works that has been developed so far related to identification of power quality disturbances using the dynamic time warping, in terms of concept, specification, implementation and other useful information that related to execute this project.

2.1 Terminology

i. **Distortion**

Qualitative term indicating the deviation of a periodic wave from its ideal waveform characteristics. The distortion introduced in a wave can create waveform deformity as well as phase shift.

ii. **Distortion factor**

Ratio of the RMS of the harmonic content of a periodic wave to the RMS of the fundamental content of the wave, expressed as a percent. This is also known as the total harmonic distortion (THD); further explanation can be found in Chapter 4.

iii. Flicker

Variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity. Quantitatively, flicker may be expressed as the change in voltage over nominal expressed as a percent. For example, if the voltage at a 120-V circuit increases to 125 V and then drops to 117 V, the flicker, f, is calculated as $f = 100 \times (125 - 117)/120 = 6.66\%$.

iv. Form factor

Ratio between the RMS value and the average value of a periodic waveform. Form factor is another indicator of the deviation of a periodic waveform from the ideal characteristics. For example, the average value of a pure sinusoidal wave averaged over a cycle is 0.637 times the peak value. The RMS value of the sinusoidal wave is 0.707 times the peak value. The form factor, FF, is calculated as $FF = 0.707/0.637 = 1.11$.

v. Frequency

Number of complete cycles of a periodic wave in a unit time, usually 1 sec. The frequency of electrical quantities such as voltage and current is expressed in hertz (Hz).

vi. Harmonic

Sinusoidal component of a periodic wave having a frequency that is an integral multiple of the fundamental frequency. If the fundamental frequency is 60 Hz, then the second harmonic is a sinusoidal wave of 120 Hz, the fifth harmonic is a sinusoidal wave of 300 Hz.