

Intelligent Decision Making in Power Quality

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Abstract—Decision making is one of the important aspects on dealing power quality issue in electrical system. The aims of conducting Decision Making process are to identify the real culprit which contribute to the Power Quality (PQ) problem. One of the vital steps on decision making aspect in PQ is the classification for difference issue in PQ aspect. This classification process is very important to give a right direction towards proposing the correct mitigation technique. In order to develop the reliable decision-making scheme, the fast and accurate classification of PQ issue need to be deployed. The use Intelligent computational approach such as Artificial Intelligence, Machine Learning and Deep Learning along with various signal processing technique have offered a vast opportunity in this research area. Hence, this keynote will focus on the direction of the Intelligent Decision Making in PQ area which pave a path towards new body of knowledge in this research area.

Index Terms— Decision Making, Power Quality, Classification.

I. INTRODUCTION

Power Quality (PQ) is defined as the electrical system work properly without any interruption or less efficient with specific characteristics voltage and/or current [1]. The obtain the good power quality, the voltage and current need to be within criteria. The specific characteristics voltage and current can be comprise of magnitude, shape and frequency. The non-compliance to the given characteristics is known as the noncompliance to quality of power technically known as Power Disturbance. Power disturbance is defined as any failure or misoperation of consumer equipment or system which resulting from voltage and/or current deviations from the given characteristics [2].

One of the steps in PQ decision making is on the classification of power disturbance [3]. This classification process is very important to give a right direction towards identifying the correct power disturbance and hence propose the correct mitigation technique for the dedicated issue. This approach could minimize the financial loses by pinpointing the root of cause, prolong the lifespan on equipment and reduce the potential electrical hazard [4].

The use of so-called advanced technologies computational intelligent such as Artificial intelligence (AI) techniques such as Machine Learning (ML), Artificial Neural Networks (ANN) And Deep Learning (DL) provide solutions to complex problems associated with decision making in PQ. On top of computational intelligent, signal processing is normally used to detect power quality (PQ) disturbances occurring in power system [5]. There are various types of signal processing introduced by researchers as they have grown an interest to explore more on signal processing with very detailed studies in an attempt to find the best way to detect power quality disturbances. The main goal of this article is to provide on the direction of the intelligent decision making in PQ area which pave a path towards new body of knowledge in this research area.

II. THE FRAMEWORK OF INTELLIGENT SYSTEM IN POWER DISTURBANCE CLASSIFICATION

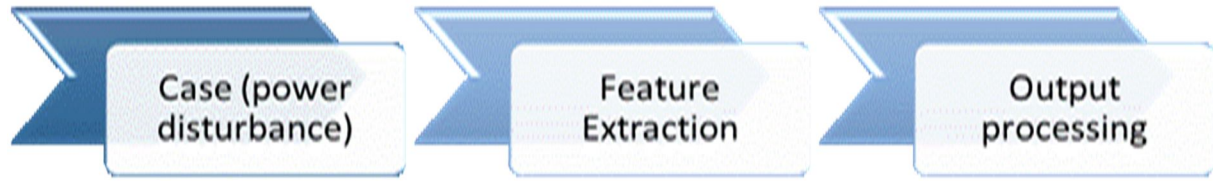


Figure 1 Framework of Intelligent Decision Making in Power Disturbance Classification

In PQ decision making framework particularly of classification mechanism, the issue which known as power disturbance should be experienced by the electrical user. This could become challenge which need to mitigate by the user and therefore the PQ expert view need to be considered to ascertain the type of disturbance which experienced by the user. For any of researchers who involve in this research area, it is advantage if himself/herself is knowledgeable in the area the decision-making mechanism as PQ need to acquire highly technical reasoning especially on identifying the power disturbance. At this stage, it is important to have a highly systematic disturbance storage so that the disturbance which capture in the electrical system can be properly extracted and analysed.

Once the power disturbance accumulating process has been completed, the next stage which called as feature extraction process is taken place. The process has basically utilized signal processing technique to extract the power disturbance features. During this process, the use of highly complex mathematical expression is essential as the signal processing are originating from mathematical principle. Equation shows the basic equation for processing technique, known S-transform (ST) technique which commonly use at this stage;

$$ST(\tau, f) = \sum_{-\infty}^{+\infty} x(t)\psi(t - \tau, d)e^{i2\pi ft} dt \quad (1)$$

Where

$x(t)$ is the electrical signal i.e voltage of current

$\psi(t - \tau, d)e^{i2\pi ft}$ is Gaussian function

The feature extraction process from the power disturbance can be depicted in Figure 2 (a) and Figure 2(b).

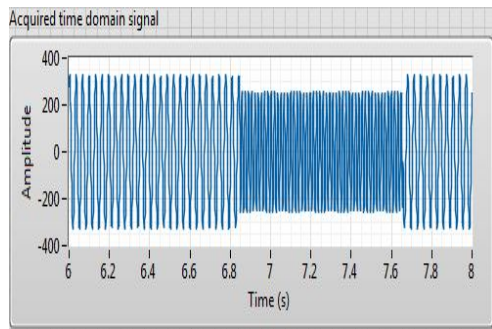


Figure 2(a) The waveform with Power Disturbance

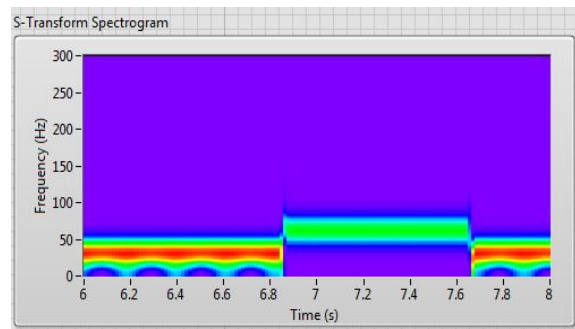


Figure 2(b) The feature extraction while using ST

The next process of decision-making scheme by referring to Figure 1 is output processing mechanism. Most of the Output in this study area is conducted base on Artificial Intelligent (AI). There are different type of AI can be used in output processing scheme such as Back Propagation Neural Network (BPNN,) Fuzzy Logic, Expert System and Support Vector Machine (SVM). AI give the decision based on the human's need by imitating the human's brain function through computer application. The use of AI in output processing technique can be referred in Figure 3. In this Figure, the decision making scheme give the final classification on two difference disturbance i.e voltage sag and voltage swell.

Classify different type of Power disturbance

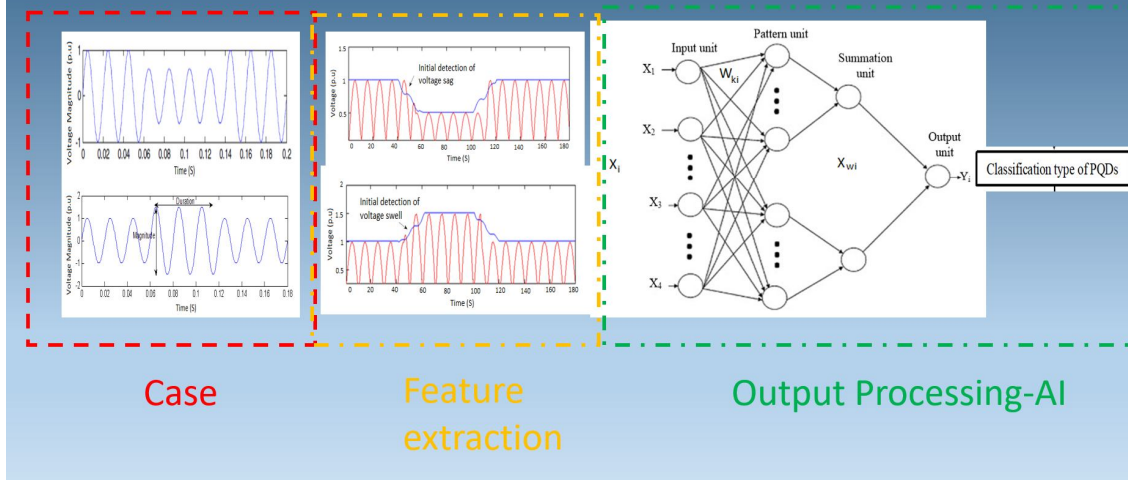


Figure 3 The use of AI in output processing technique

III. CONCLUSIONS

In the current scenario, the challenge in PQ decision making process is becoming more complex. With the emerging of smart grid, distributed generation, and new type of electrical load produce difference type of PQ scenario, the new model development which could lead to the new body of knowledge could be one of the potential area to be explored. As for feature extraction part, the advance signal processing and the use of rigorous mathematical statistics is more important since the power disturbance is more dynamic and prone to expose to the external factor. In the era IR 4.0 which focusing on integrating the autonomous decision making, cloud technology and machine learning through cyber physical, the exploration for output processing part become more explosive. In the nutshell, PQ decision making is remained important due to dynamic environment of electrical area in recent decade.

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