ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

Identification, Categorization and Mitigation of Power Quality Issues in a Power System

Mohammad Zubair[1], Prof.K.K.Rajput[2], Dr.M.A Bag[3], Dr.C.M.Jadhao[4]

PG Student [EPS], Dept. of ELPO, MGI-COET, Shegaon, Maharashtra, India[1]

Head, Dept. of ELPO, MGI-COET, Shegaon, Maharashtra, India[2]

Professor, Dept. of ELPO, MGI-COET, Shegaon, Maharashtra, India[3]

Principal, MGI-COET, Shegaon, Maharashtra, India[4]

ABSTRACT: In this paper, a real MSEDCL subdivision shegaon 33/11 KV distribution system is taken under study to identification and Categorization of Power Quality Events. The PQ Events to be classified from actual Distribution system, to create 11 KV Industrial Feeder simulated in (PSCAD) Software. the purpose to present a novel method for the identification and classification of Power Quality issues. This paper focus on Discrete Wavelet Transform (DWT) is used to identify. i have done one an half my project works. PQD identify is 50% work. Remaining work is to Categorize Power quality disturbance by using Artificial Neural Network (ANN). Power quality disturbances are localized by Discrete Wavelet Transform in time and frequency domain. (Energy) Statistical parameter is calculated from detailed coefficient of DWT which is given as input to ANN to Categorize Power quality disturbances such as Voltage sag, Voltage swell and Interruption. Discrete Wavelet-transform to detection therefore Wavelet transforms has received greater attention in power quality. Wavelet transform is more than efficient to other transform.

KEYWORDS: Power quality disturbance, wavelet transform (DWT), Artificial Neural Networks (ANN), Power System Computer Aided Design (PSCAD) Software.

I.INTRODUCTION

O Now our modern society is heavily dependent on the electricity. Our life cannot be imagined without the electrical energy. Now our daily used of equipments which are being used in electrical then we require purely and continuously electrical supply, because of the quality and continuity of the electric power supplied is also very important for the efficient working of the end user equipment. Most of the commercial and industrial loads demand high quality continuous power. Power quality is basically the dealings of electrical power with electrical equipment. Our industrial and domestically equipment to operate properly and consistently without damaged. We would say that power is good quality. On the other hand, those are more sensitive to Power Quality. These equipments contain power electronic devices which are sensitive to power instability. So, any type of PQ disturbance occurs in the voltage current or frequency of the power signal that can also affect the utilities end which is called power quality problem. major problems which can cause faults and malfunctioning or tripping of equipment. A voltage sag when phase voltage drops and certain faults occurs like a LG,LLG,LLLG, fault due to fault voltage drops below the specified tolerance for a short period of time.

II.LITERATURE SURVEY

Reference [1]. K.Chandrasekaran, In this paper, a Power Quality Provider (QPP) is proposed and modelled by simulation.. The QPP has a novel feature of performing dual functions of mitigation of sag and suppression of harmonics quickly, dynamically and simultaneously using a simple unique and novel control scheme. The QPP will be connected close the sensitive loads which are to be protected in the distribution network. For a case study the hospital distribution network which supplies many life saving equipments such as MRI, CT scan, computerized surgery equipment, etc. at Ipoh, Malaysia was chosen to conduct experiments. Experimental results prove the credibility of

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

QPP in mitigating power quality disturbances effectively, such that the voltage at the sensitive loads are at the rated value and sinusoidal. The design, modelling and simulation are done using PSS/ADEPT and PSCAD software.

Reference [2]. P. P. Shinde*,In this paper, performance of a wavelet-based voltage disturbance detection method is evaluated using back-to-back switching of wye and delta connected capacitor bank and single phase fault. The simulation results shows, that in all cases, wavelet-based method properly detects the voltage disturbance scenario and the detection time is also less than conventional methods. However, secondary circuit logic can be developed to avoid false tripping of STS and DVR. It is believed that the work carried out in this paper is useful for the power quality engineer for analysis of voltage disturbance.

Reference[3]. Masoud Karimi,*presents a new method of on-line voltage disturbance detection based on Wavelet transform. It depends on simulation of large number of faults and Capacitor switching incident. The method identifies the voltage disturbance and also classify the type of event occurs in the voltage disturbance. The characteristic of each disturbance depends on type of event, location, time instant and network configuration. In this, a probability function is defined and the decision is made using “Maximum Likelihood” (ML) criteria which based on maximizing the probability function of the features. The ML criteria searches for the event which maximizes probability function p.

III.OBJECTIVE OF WORK

The main objective of this paper, Identification, Categorization Power Quality Issues in a Power System. The Power Quality issues are detected using Discrete Wavelet transform (DWT) the following types of Power Quality events (i) Voltage Sag (ii) Voltage Swell (iii) Interruption.

IV. POWER QUALITY DEFINATION

The IEEE standard to define power quality as the concept of powering and grounding sensitive electronic equipment in a manner that is suitable to the operation of that equipment . The quality of electric power delivered is characterized by two factors namely “continuity” of supply and the “quality” of voltage. As indicated by IEEE standard 1100, Power Quality is characterized as- "The idea of controlling and establishing the touchy supplies in a manner that is suitable for the operation of the gear." It is define as any power problems demonstrate, in voltage, current or frequency variation that results in failure or mal-operation of end user equipment. Power quality is basically the dealings of electrical power with electrical equipment. Our industrial and domestically equipment to operate properly and consistently without damaged. We would say that power is good quality. In other side, if the electrical equipment malfunctions, is unreliable, therefore to damaged during normal usage, we would suspect that the power quality is poor. Power Quality has become an important issue to both power utilities and their customers. The wide use of non-linear loads and electronics equipment can cause power disturbance which then lead to poor power quality. Poor power quality is normally caused by power line disturbance resulting in failure of End user equipment. It is the measure, analysis and improvement of bus voltage (load bus voltage), to maintain that voltage to be sinusoid at rated voltage and frequency. It is the power that has sinusoidal voltage and current without any distortion and operates at the designed magnitude and frequency. [10-13],

V.SIGNAL PROCESSING TECHNIQUES

Feature extraction, classification has a most important role because each disturbance has exclusive features than the others. The basic task of feature extraction technique to classify the PQ Events consequently . Different digital signal processing techniques are obtainable for feature extraction such DFT. Two stages of categorization of PQ events, Discrete Wavelet Transform First wavelet coefficients Hd(n) and Gd(n) have to be determined. the signal X(n) represents in the wavelet domain. After the this first stage, fairly accurate and detailed coefficients have to be calculated from the decomposed power signal.. After the disintegration of power signal, to get the unique signal in time domain, reverse Fourier transform has to be applied. So the signal X (t) in wavelet domain is as below:

$$WTx(a,b) = \int_{-\infty}^{\infty} S(t)\psi(a,b)\,dt \quad ---1$$

$$\text{where} \quad \psi_{a,b}(t) = \psi((t-b)/a)\sqrt{a} \quad ----2$$

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

Is a scaled and shifted version of the mother wavelet ψ (t).The parameter a corresponds to scale and frequency domain property of ψ (t).The parameter b corresponds to time domain property of ψ (t) .In addition $1/\sqrt{a}$ is the normalization value of ψ a,b(t) for having spectrum power as same as mother wavelet in every scale. The DWT is introduced by considering sub band decomposition using the digital filter equivalent to DWT. The Band pass filter is implemented as a low pass and high pass filter pair which has mirrored characteristics. While the (LPF) low pass filter approximates the signal. The high pass filter (HPF) provides the details lost in the approximation.

A) Fourier Transform: The Fourier Transform is one of the old technique and most powerful tools in signal processing. This transform plots the signal in time domain to a frequency domain wherever certain useful properties about the signal can be seen. Fourier Transform *F (jω)* of f (t) is given as

$$F(j\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-jwt}\, dt \qquad (3)$$

B) Wavelet Transform: Wavelet transform is also a mathematical tool for signal analysis. Wavelet transform analysis is very efficient where the signal being analysed has transients or distortions in the voltage and current waveforms. The basic theory of wavelet analysis is to elect an appropriate wavelet function called as mother wavelet and then perform analysis using shifted and dilated version of this wavelet.

C) Discrete Wavelet Transform (Dwt):DWT is any wavelet transform in which the wavelet is discretely sampled. It transforms the distorted signal into different time frequency scales detecting the PQD present in the power signal. The DWT of f(t) is defined as:

$$\text{DWT} \qquad F(a,b) = f(t)\psi a,bd - - - - - (4)$$

where, ψ a,b(t) is mother wavelet a,b are scale and translation factor DWT These techniques have become most accepted technique for recognition of power quality Events. Discrete Wavelet transform, which able to analyze these power quality problems at the same time in both time domain and frequency domain is used to extract features of the problems by decomposing (db4) the signal using multi resolution analysis (MRA). These features are used to identify and restrict the disturbances. Wavelet transform is a powerful tool for detection and classifications of PQ disturbances. Recent advances in signal processing and pattern recognition have led to the development of several new classification approaches, which are based on discrete wavelet transform, multi resolution signal decomposition, polynomial approximation. The wavelet transform of a continuous signal *f(t)* is:

$$F(a,b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{\infty} f(t)\psi\left(\frac{t-b}{a}\right) dt \qquad \text{---------- (5)}$$

VI. SIMULATION MSEDCL SUBDIVISION SHEGAON 33/11 KV DISTRIBUTION SYSTEM:

A single line diagram of a 11 KV Industrial Feeder from actual Distribution system of Shegaon substation. This system is taken under study for identify and classify power quality events occurring in it. It consists of Substation transformer (Power transformer 33/11KV, 5 MVA), 12 Distribution transformer, a Capacitor bank and load. The detail configuration of the system under study is given in single line diagram shown in below. A 33/11 KV MSEDCL Distribution system is simulated in PSCAD, shown below simulation diagram of a Distribution system.

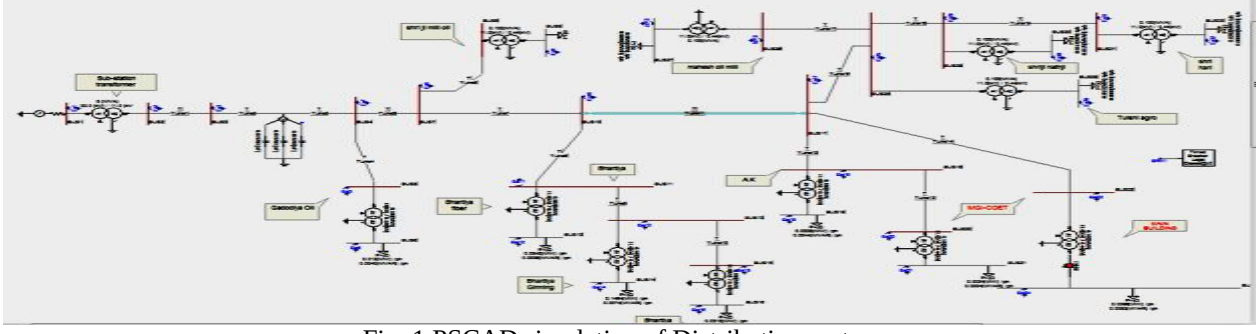

Fig. 1 PSCAD simulation of Distribution system

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

VII.PROPOSED METHODOLOGY

Under study to create distribution system and to simulate in PSCAD software, power quality events such as voltage sag, voltage swell and interruption are created in the system. Then voltage signals at different buses are captured and stored in excel sheets by sampling them at 7680Hz.These excel sheets are then imported to MATLAB program for DWT analysis. For DWT analysis DB4 wavelet is used and decomposition is 7 levels.

i)Voltage Sag : When a LG fault occurs at Bus No.24 then the voltage waveform at Bus No.24 is shown below.

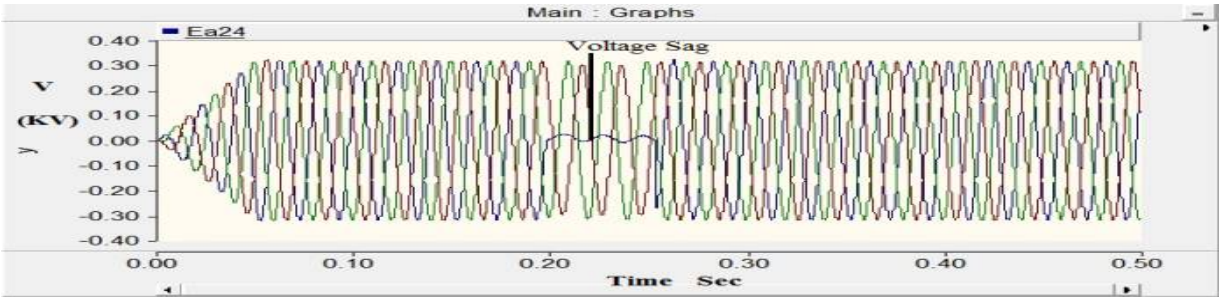

Fig.2 Voltage waveform for Voltage sag on Bus 24

(ii) Voltage swell: When a heavy load is switch-off bus34, then the voltage waveform at Bus No.24 is as shown below

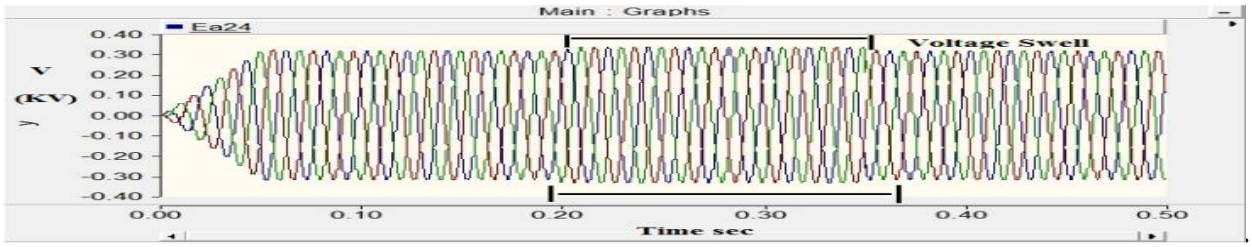

Fig.3 Voltage waveform for Voltage swell on Bus no.24

(iii) Interruption: when a inadvertent operation of a Circuit breaker take place, then the voltage waveform at bus no.24 is shown below.

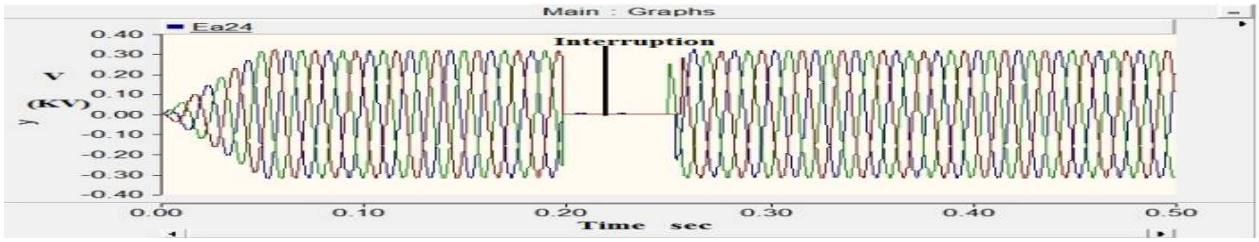

Fig. 4 Voltage waveform for Interruption on Bus no.24

VIII.ARCHITECTURE OF ANN

ANN is defined as a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs. An artificial neural network is a system based on the operation of biological neural networks, in other words, is an emulation of biological neural system. Why would be necessary the implementation of artificial neural networks? Although computing these days is truly. Neural networks are naturally organized in layers. Layers are made of a number of interconnected “nodes” which contain

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

"activation function". Patterns are offered to the network via the "input layer", which communicates to one or more "hidden layers" where the actual processing is done via a system of weighted "connection". The hidden layers then link to an "output layer" where the answer is output as shown in the graphic below.

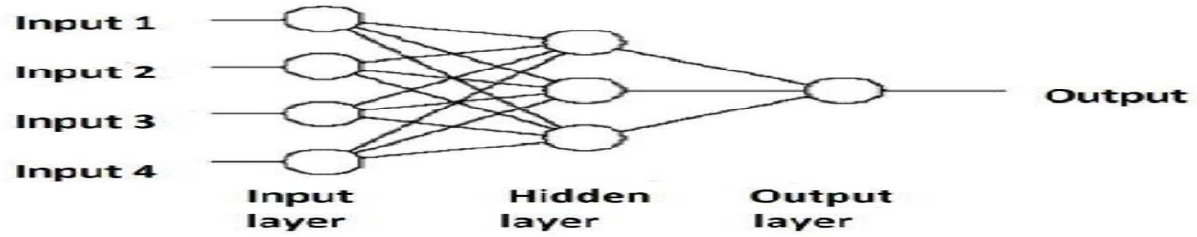

Fig.5. ANN architecture

An input is accessible to the neural network and a resulting desired or a target response set at the output (it case the training is called supervised). A fault is composed from the difference between the desired response and the system output. This error information is feedback to the system and adjusts the system parameters in a orderly approach. The process is repeated until the performances are acceptable. this explanation that the performance hinges heavily on the records. If it does not have data that cover a important portion of the operating conditions or if they are noisy, then neural network technology cannot give the right solution. On the other hand, if there is plenty of data and the problem is poorly understood to derive an approximate model, then neural network technology is giving a good solution. In artificial neural networks, the designer chooses the network topology, the performance function, the learning rule, and the criterion to stop the training phase, but the system automatically adjusts the parameters. So, it is difficult to bring a priori information into the design, and when the system does not work properly it is also hard to incrementally refine the solution. But ANN is best solutions and efficient in terms of development time and resources, and in numerous difficult problems artificial neural networks provide performance that is difficult to match with other technologies.

IX.MULTILAYER PERCEPTRON (MLP)

A multilayer neural network includes an input layer, an output layer, and one or more hidden layers. Each layer may include various neurons. A neuron in each layer of the network is connected to all the nodes or neurons in the preceding layer (Haykin,1999) . Multilayer perceptrons (MLPs) are layered feed forward networks classically trained with static back spread. It specifies the number of hidden layers. These networks have initiated their way into incalculable applications requiring static pattern categorization. its reward are that they are easy to use, and they can approximate several input and output map. The important disadvantages are that they train slowly; it is require lots of training data (naturally 3- times more training samples than network weights).A Multi-Layer Perceptron (MLP) is an artificial neural network generally used for classification or approximation. The MLP consists of a feed-forward network of neurons which map input vectors to output vectors. Each artificial neuron consists of a linear combination of weighted inputs which is passed though a non-linear activation function to produce the neuron's output. The term "MLP" often causes confusion. The model is not a single Perceptron that has multiple layers it contains several perceptrons that are organized into layers, leading some to believe that a more fitting term might therefore be "multilayer perceptrons network". Additionally, these "perceptrons" are not actually perceptrons in the strictest possible sense, as true perceptrons are a special case of artificial neurons that use a threshold activation function such as the Heavy side step function; whereas the artificial neurons in a multilayer perceptrons are free to take on any arbitrary activation function. Accordingly, whereas a true Perceptron performs dual classification, a neuron in a multilayer perceptrons is free to either perform classification or degeneration, depending upon its activation function. There are two urging raised above can be acquiescent with the name (MLP) 'multilayer perceptrons' and if multilayer "perceptrons" is simply interpreted to mean a dual classifier, independent of the specific practically execution of a standard Perceptron.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

X.MITIGATION OF PQ EVENT BY FACTS DEVICES

The various problems that affect the quality of power in a system . It discus the causes and effects of the problem . It is the most frequently occurring problem. The characteristics and also the mitigation techniques are discussed to give an overview on the power quality issues. Among the various mitigation techniques are available, the use of custom power devices is the most effective and efficient solution. Power quality problems have been discovered for decade. The presence of voltage disturbances at the point of common coupling (PCC) results in malfunction of sensitive industrial instrumentality, that turn out grid part failures, such as transformers, and economical losses. It is generally based on power electronics device. Flexible Alternating Current Transmission System devices are used to overcome every power quality problems and they are given possible answer to shield sensitive loads against the most significant voltage disturbances, voltage harmonics, interruption, imbalance and sags flicker so on. The Dynamic Voltage Restorer has most popular for mitigate of power quality issue. it is provide solution as a cost effective and also to protection of sensitive loads from power quality problems such as voltage sags and swells. The control for DVR based on dqo algorithm was discussed in. it important role in this and it is not only compensator but also to mitigate the effects of voltage sag, to reduce the harmonic distortion due to the presence of nonlinear loads in the network. In this proposed method, a series compensator was proposed, in this method how to compensation harmonic is discussed, to mitigate voltage sag was investigated by S.Sadaiappan.[8].

XI.CONCLUSION

In this paper, a complete simulated system has been developed by using the PSCAD software. This paper presents a novel DWT-ANN approach for identification of Power Quality issues such as voltage sag, voltage swell and interruption. DWT localizes the Power Quality disturbances in time and frequency domain.this work is 50% only because of power quality issues are only identify and seven level decomposition in this paper. futher works, to classify Power quality issues by ANN. I will complete further task as soon as possible and I'll definitely publish my further Categorization of power quality by usin ANN. 100% accuracy for Categorization of above three power quality events. The information obtained in the current study will be helpful to understand the mitigation techniques using FACTS devices of power quality problems in the electrical network.

XII.FUTURE SCOPE

power quality disturbance Categorization by using ANN and power quality disturbance to mitigation offline and online.

REFERENCES

[1] K. Chandrasekaran, 2P.AVengkatachalam, 3Mohd Noh Karsiti , 4K.S.Rama Rao'Mitigation Of Power Quality Disturbances Journal of Theoretical and Applied Information Technology © 2005 - 2009 JATIT.
[2] P. P. Shinde*, D. R. Narkhede, R. K. Munje* and B. E.Kushare*,Voltage Events Detection using Wavelet Transform for Power Quality Applications, 978-1-4799-5364-6/14/$31.00 ©2014 IEEE.
[3] Masoud Karimi, Hossein Mokhtari, and M. Reza Iravani, Wavelet Based On-Line Disturbance Detection for Power Quality Applications, IEEE Transactions On Power Delivery, Vol. 15, No. 4, October 2000.
[4] Mario Oleskovicz*, Denis V. Coury, Odilon Delmont Felho, Wesley F. Usida, Adriano A.F.M. Carneiro, Leandro R.S. Pires , "Power quality analysis applying a hybrid methodology with wavelet transforms and neural networks", Electric Power and Energy System 2009,206 - 212.
[5] Murat Uyara, Selcuk Yildirima, Muhsin Tunay GencoglubAn effective wavelet-based feature extraction method for classification of power quality disturbance signals Electric Power Systems Research 78 (2008) 1747–1755
[6] ZWE-LEE GAING ,Implementation of Power Disturbance Classifier Using Wavelet-Based Neural Networks.2013IEEE Bologna power tech Conference, june 23th-26th, bologna,Italy.
[7] S. Sadaiappan, P. Renuga and D. Kavitha "Modeling and Simulation of Series Compensator to Mitigate Power Quality Problems", International Journal of Engineering Science and Technology, Vol. 2, No. 12.
[8] Chong Han, Zhanoning Yang, Bin Chen, Alex Q. Huang, Bin Zhang, Michael R. Ingram and Abdel Aty Edris "Evaluation of Cascade-Multilevel- Converter-Based STATCOM for Arc FurnaceFlicker Mitigation", IEEE Transactions On Industry Applications, Vol. 43, No. 2, March/April 2007.
[9] Abhijit Padol, "Power Quality Events Categorization in A Distribution System" International Conference on Electrical, Electronics and Computer Science(ICEECS) ISBN: 978-3-642-24819-9, 20th April 2014, Nagpur.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 5, May 2017

[10] S.Khokhar, A.A.Mohd Zin, A.S.Mokhtar,Automatic Classification of Power Quality Review. 2013 IEEE Student Conference on Research and Development (SCOReD), 16 -17 December 2013, Putrajaya, Malaysia
[11] Devendra Mittal, Classification of Power Quality Disturbances in Electric Power System: A Review. ISSN:2278-1676 Volume 3, Issue 5 (Nov- Dec. 2012), PP 06-14.
[12] Nantian Huang, Review of Power-Quality Disturbance Recognition Using S-transform, 978-0-7695-3728-3/09 $25.00 © 2009 IEEE DOI 10.1109/CASE.2009.96.
[13] Mehebub Alam,"Power Quality Problems and Solutions: An Overview" Volume 3 Issue 10, October 2014
[14] Anurag Agarwal, Sanjiv Kumar, A Research Review of Power Quality Problems in Electrical Power System, MIT International Journal of Electrical and Instrumentation Engineering, Vol. 2, No. 2, Aug. 2012, pp. (88-93).