iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IX **Month of publication:** September 2018

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IX, Sep 2018- Available at www.ijraset.com

Enhancement of Power Quality Using Dynamic Voltage Restorer (DVR) in Low Voltage Distribution System

B. Ram Vara Prasad[1], K. Priyanka[2], K. Alfoni Jose[3]
[1, 2, 3] *Assistant Professor, Department of Electrical and Electronics Engineering, Lendi Institute of Engineering and Technology Jonnada, Vizianagaram, Andhra Pradesh, India*

Abstract: ***In low voltage distribution system, the power quality disturbance due to voltage swell and sag is minimized by using an custom power device called Dynamic Voltage Restorer (DVR) which is placed between the supply voltage and sensitive load. New configuration of DVR with improved d-q-o controller has been proposed. The simulations are performed using Matlab/ Simulink's Sim Power Toolbox.Industries which uses sensitive loads rapidly causes several problems like voltage swell, sag, transient and unbalance etc, which leads to generate more losses and creates disturbances which in turn leads to malfunctioning of the apparatus and sometimes to shutdown even.In order to prevent equipment from these disturbances and malfunctioning several methods are available but the most commonly used methods is the use of DVR . "Dynamic Voltage Restorer" acts as the series voltage controller. DVR is an important tool to mitigate disturbances related to power quality problems in the low voltage distribution network.***

Keywords: voltage swells, distribution system, Dynamic Voltage Restorer, sensitive load, d-q-o controller.

I. INTRODUCTION

Complex networks such as hundreds of generating stations and thousands of load centers are interconnected which involves Modern power systems , which are connected to each other by the use of long transmission and distribution network.In the view of customers Quality and reliability of power is mainly considered at various load centers. In developed countries the generation of power is fairly reliable and the quality of the power is not reliable completely. An uninterrupted and smooth sinusoidal voltage should be provided by the Power distribution systems, at the required magnitude and frequency.

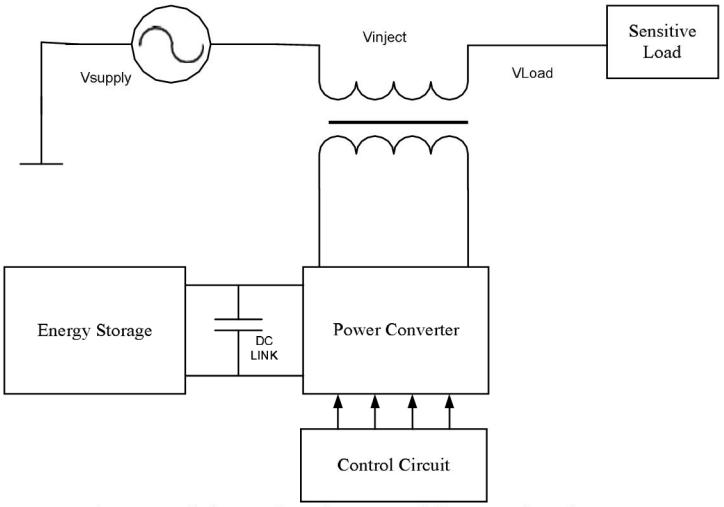


Figure 1: Schematic Diagram of Conventional DVR

But, in practical conditions, the distribution network includes mostly the non-linear loads, which affects the quality of power significantly. Therefore, the sinusoidal voltage gets disturbed due to the presence of non-linear loads, harmonics etc, it loses the purity, and this is the origin of power quality problems. Apart from nonlinear loads, some systems even include both regular (e.g. condenser switching, motor starting) and irregular (e.g. faults) could also inflict power quality problems.

©IJRASET: All Rights are Reserved

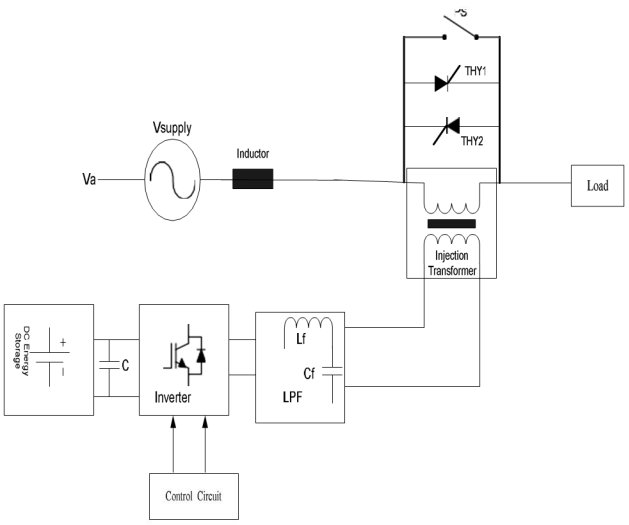


Figure 2: Typical DVR Circuit Topology (Single-Phase Representation).

The response of the natural system with the function of time is considered as the transient response. Electromagnetic transient studies have always played an essential behavior of the system in the event of different forms of transient phenomena, which can hardly be achieved by other means. This project addresses the transient studies of electrical networks with power electronics-based, FACTS and Custom Power (CP) controllers. A considerable percentage of power system studies rely on electromagnetic transient simulations. The CP controllers include Dynamic Voltage Restorer (DVR).This paper is organized as the theory behind Voltage Source Converter (VSC) based Controllers namely DVR and the PWM scheme adopted in this paper is described. The test cases are presented and the simulation results are discussed and finally conclusive remarks are drawn.

II. THE NEW PROPOSED CONFIGURATION OF DVR

The new model of the proposed DVR is shown in Figure 3.This new model we use three single phase of the injection transformer. All three injection transformer can be connected either in delta/open or star/open configuration. In this paper all three series injection transformer was connected as delta/open. In this paper the DVR circuit consists of the 3-leg inverter which has 6 IGBT switches and the battery as a dc energy storage. The low pass filters are used to convert the PWM inverted pulse waveform from DC to AC conversion in the VSI. In this model, the filters are installed in both the high voltage side and the low voltageside.

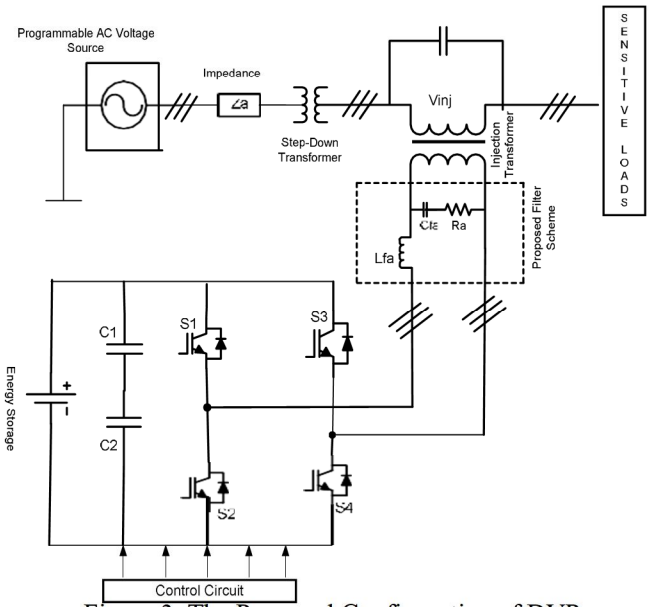


Figure 3: The Proposed Configuration of DVR

©IJRASET: All Rights are Reserved

When filters are placed in low voltage side, high order harmonics from the three phase voltage source PWM inverter is by pass by the filtering configuration and its impact on the injection current rating can be ignored [14]. The type of this filtering configuration can also eliminate switching ripples produced by theconverter.

As for the filtering configuration is placed in the high voltage side. In this case, high order harmonic currents will penetrate through the injection and it will carry the harmonic voltages. When compensate the voltage sag/swell at the critical load, DVR produce a harmonics distortion fed from series transformer as an injection voltage to the critical load. Using the Fast Fourier Transform (FFT) analysis to analyse the Total Harmonic Distortion (THD) for the voltage signal. The proposed of the filtering configuration results a THD value of about 1.4%.

III. THE CONTROL OF DVR SYSTEM

The Control of DVR system using d-q-o Park's transformation technique in. Figure 4 show the main components of the control system .The control system consists of 6 blocks and each, block has its function and can be described as follows:

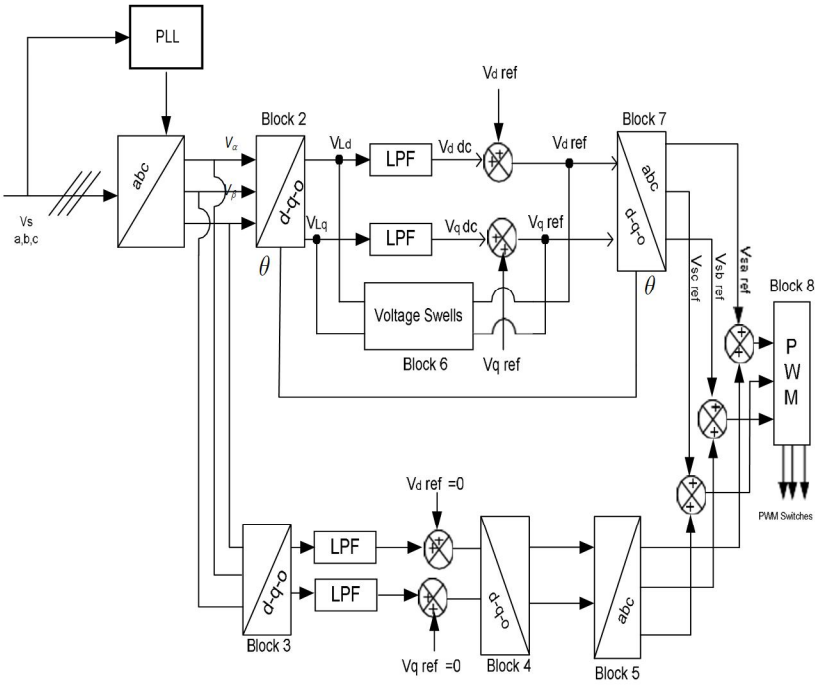


Figure 4: Block Diagram Control Scheme of DVR for Voltage Swells

Block 1 is used to convert the three phase load voltages (Vsa, Vsb, Vsc) into the α-β-0 coordinates.Block 2 and block 3 is the α-β-0 to d-q-o transformation blocks which are used to convert the three phase load voltages reference components V_α ref, V_β ref and V_o ref to V_d ref, V_q ref and V_o ref.

In the control scheme the Block 4 is used to convert the d-q-o to α-β-0 and the block 5 is used for transformation of the α-β-0 to a-b-c. By using the three-phase PLL angle θof the source voltage can be obtained. The detection and reference voltage generation is done by information extracted from the PLL. The detection scheme for the voltage unbalance compensator is showed in block 6. Figure 4 shows that the synchronous frame variables –Vd and Vq- are used as inputs for low pass filters to generate voltage references in the synchronous frame. Block 7 receives the components of the load voltage vectors Vd ref and Vq ref and transforms them to three-phase coordinates and the generation voltages are used as the voltage reference. The DC link error in Figure 4 is used to get optimized controller output signal because the energy on the DC link will be changed during the unbalance voltage. Block 8 is the PWM block which provides the firing for the Inverter switches (PWM1 to PWM6). The difference between the reference load voltage and the supply voltage is injection voltage which is generated and is then send to the voltage source converter (VSC).

©IJRASET: All Rights are Reserved

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IX, Sep 2018- Available at www.ijraset.com

IV. MATLAB BASED SIMULATION OF DVR SYSTEM:

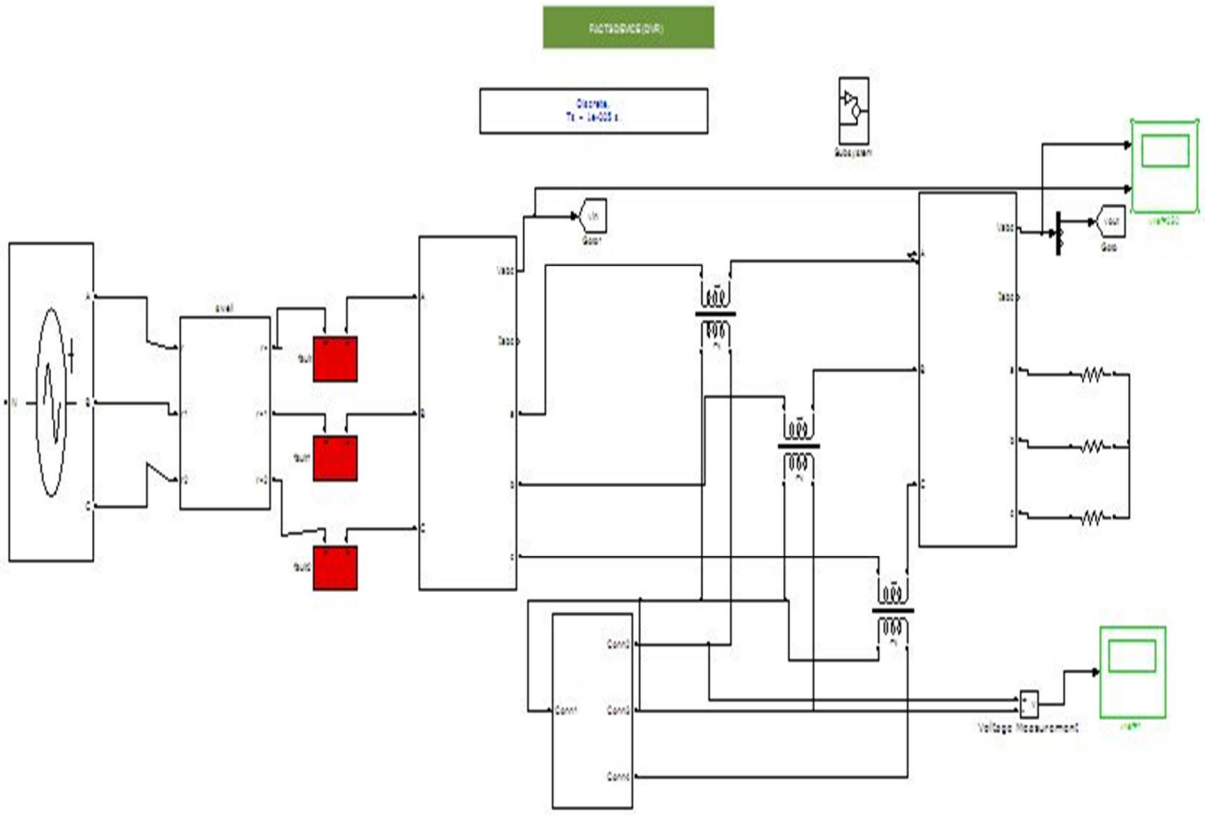


Figure 5: The Matlab/Simulink Model of the Proposed DVR

The DVR voltage which is injected in to the transmission line during sag condition is shown below.

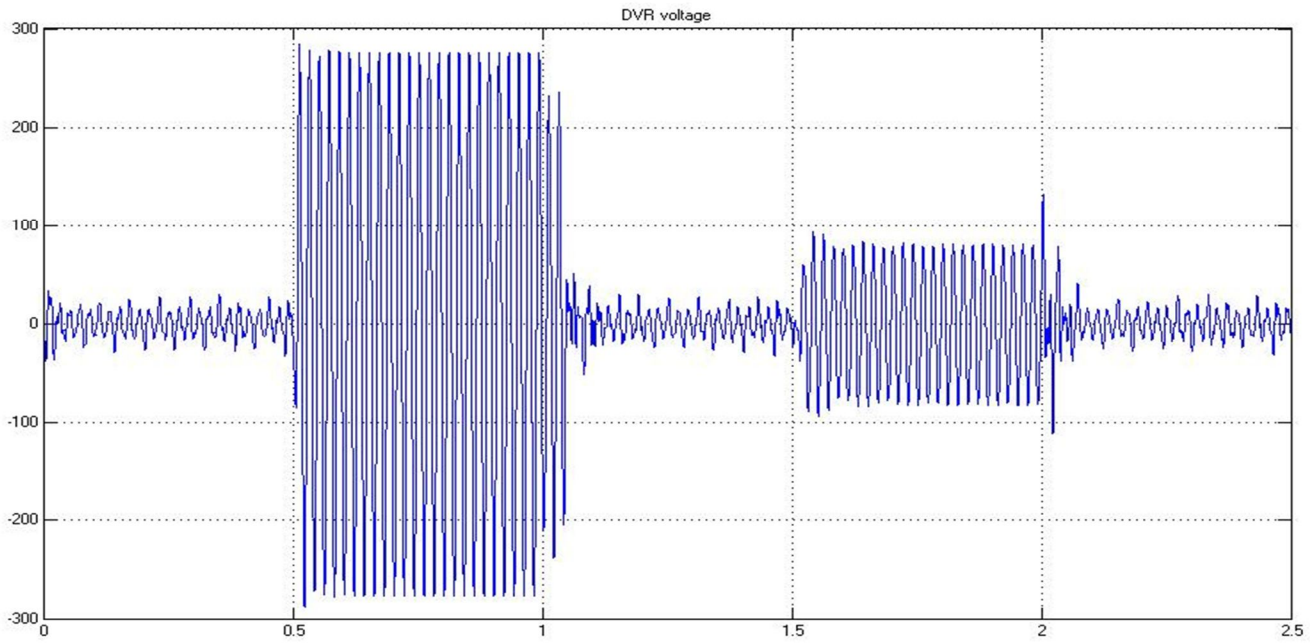


Figure 6: The Matlab/Simulink Result of The Injected DVR Voltage to the System

©IJRASET: All Rights are Reserved

By simulating the proposed circuit the output voltage , which is obtained by using DVR in the distribution system is shown below.

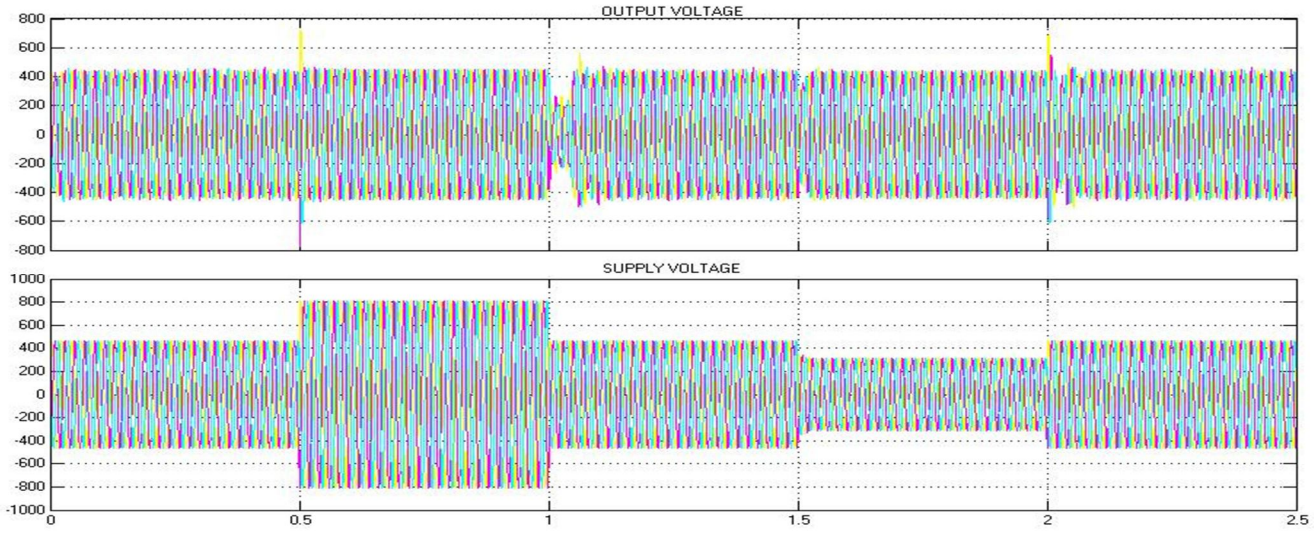


Figure 7: The Matlab/Simulink Results of the Input and Output Voltage of the System

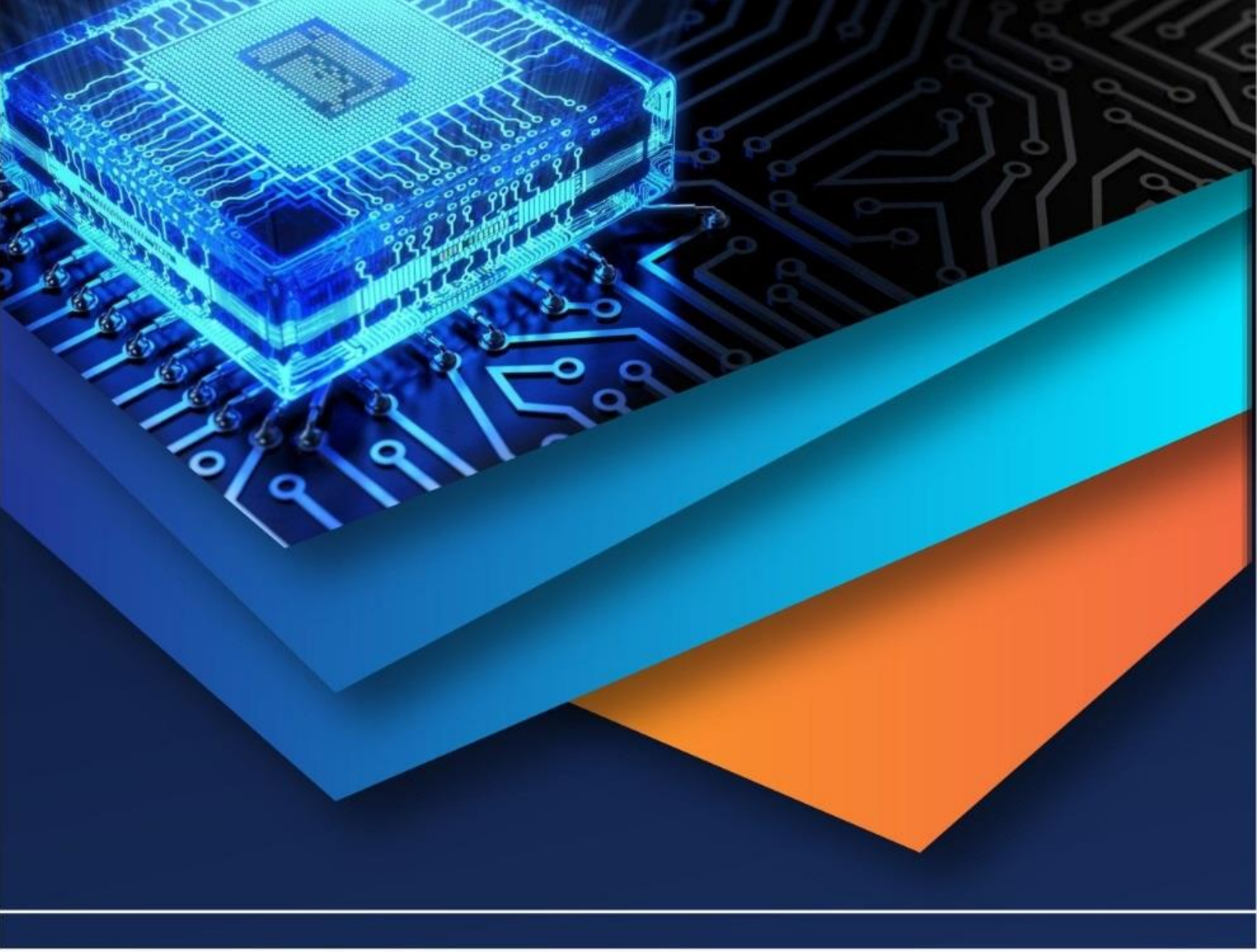
V. CONCLUSION

This project presents that the power quality problems in low voltage distribution systems like voltage swell can be mitigated by using a new compensation voltage control scheme which was proposed in this paper. The proposed method i.e., the dynamic voltage restorer can protect the consumer's equipment from potential voltage swells. The mitigation of voltage swell by using DVR was proved experimentally by using matlab and simulation and was shown in the paper. These results validate the proposed strategy for the detection and control of the various power quality problems in low voltage distribution systems. These matlab and Simulink results also shows that the of power quality problems like voltage swells can be compensated very quickly and smoothly and the source voltage fault can be compensated by series voltage injection transformer.

REFERENCES

[1] IEEE Standards Board (1995), "IEEE Std. 1159-1995", IEEERecommended Practice for Monitoring Electric Power Quality". IEEE Inc. New York.
[2] D. Sabin, "An assessment of distribution system power quality," Elect.Power Res. Inst., Palo Alto, CA, EPRI Final Rep. TR-106294-V2, vol. 2, Statistical Summary Report, May1996
[3] M.H.J. Bollen, Understanding power quality problems: voltage sags and interruptions, New York, IEEE Press, 1999
[4] M. Vilathgamuwa, A. A. D. RanjithPcrcra and S .S. Choi, "Performance improvcmcntof the dynamic voltage restorer with closed-loop load voltage and current-mode control",IEEE Transactions on Power Electronics, vol. 17, no. 5 ,Sept. 2002, pp. 824-834.
[5] Li, B.H., S.S. Choi and D.M. Vilathgamuwa, 2001. Design considerations on the line-side filter used in the dynamic voltage restorer: IEE Proc. Generat.TransmissionDistribut., 148: 1-7.
[6] Chan, K., 1998. Technical and performance aspects of a dynamic voltage restorer. In IEE Half Day Colloquium on Dynamic Voltage Restorers-Replacing Those Missing Cycles, pp: 5/1- 525.
[7] L.D. Zhang, M.H.J. Bollen, Characteristics of voltage dips (sags) in power systems, IEEE Int. Conf. On Harmonics and Quality of Power (ICHQP) , October 1998 , Athens, Greece
[8] Sng, E.K.K., S.S. Choi and D.M. Vilathga-Muwa,2004. Analysis of series compensation and DC-link voltage controls of a transformerless self-charging dynamic voltage restorer. IEEE Trans. Power Delivery, 19: 1511-1518.
[9] Zhan, V.K Ramachandaramuthy, AArulampalam, C.Fitzer, Barnes, "Dynamic Voltage Restorer based on voltage space vector PWM control",Sixteenth Annual IEEE, Applied Power Electronics Exposition, 2001, APEC 2001,Volume:2,4-8 March 2001, pp. 1301-1307.
[10] Fitzer, Chris,et al. Mitigation of Saturation in Dynamic Voltage Restorer Connection Transformer; IEEE Transactions On Power Electronics, Vol 17, no.6, November 2002
[11] MIDDLEKAUFF, W;COLLINS JR, E. Randolph; "System and customer impact: considerations goes series custom power devices";IEEE Transaction on Power Delivery,vol 13, pp 278- 282, jan 1998
[12] Nakajima , Tatsuhito, et al, the new control method preventingtransformer DC magnetization goes voltage source selfcommutatedconverters; IEEE Transaction On power Delivery, Vol. 11, no. 3, July 1996
[13] TMS 320C281x Event Manager Reference Guide (SPRU065), Texas Instrument.
[14] MS 320C281x Analog to digital converter Reference Guide(SPRU060), Texas Instrument

©IJRASET: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)