International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

A Comprehensive Study on Unified Power Quality Conditioner

A Literature Review

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Abstract- **The Unified Power Quality Conditioner (UPQC) is utilized to enhance the power quality and depends on the association of an series dynamic channel and a shunt dynamic channel. The subsequent topology has the attributes of the two channels and can remunerate voltage and streams unsettling influences and enhances the client's energy quality. The topology in light of current source converters (CSC-UPQC) has a decent unique conduct to alleviate voltage unsettling influences as it utilizes a first request channel in the series organize. This permits a fast reaction while utilizing low exchanging frequencies without the issues related with the reverberation of the second request channel as required in the voltage source topology. This work builds up a control conspire in light of a non-direct control plot for stack current consonant compensation by the shunt organize. The proposed control scheme regulates the load voltage under fast PCC voltage disturbances meanwhile the load currents harmonics are mitigated.**

Key words: PCC voltage disturbance, unified power quality conditioner, harmonic mitigation, decoupled control strategy, series active filter, shunt active filter, voltage, quality, switching frequency, second order filter, voltage source topology, nonlinear scheme load current harmonic compensation, load voltage control.

I. INTRODUCTION

Presently days, clients and ventures utilize electronic gadgets what's more, converter, these hardware gadgets draws the harmonics what's more, receptive power which influences the network productivity. Due to increasingly utilization of non direct loads and power converters gadgets in industry and furthermore by buyer, it can be watched an expanding in hang of the power network voltage furthermore, current waveform. Keeping in mind the end goal to give quality energy to end clients, different power gadgets and power network engineers builds up the gear.

In control network, quality power is provided by utilizing Bound together power quality conditioner gadget. The UPQC is method for all the while dynamic separating the supply voltage and load current. UPQC is for the most part a joint effort of series and shunt control channel associate consecutive by normal dc interface. In the most recent years, investigates have been done to build the execution of UPQC and diminish the intricacy of outline of controller. For the most part, in bound together power quality conditioners series dynamic channel is utilized for repaying supply voltage while the shunt one is utilized for compensate stack current. In this way, series converter fills in as a coordinated non sinusoidal voltage source and shunt converter fills in as non sinusoidal current source. Series of UPQC is appeared in fig.1.

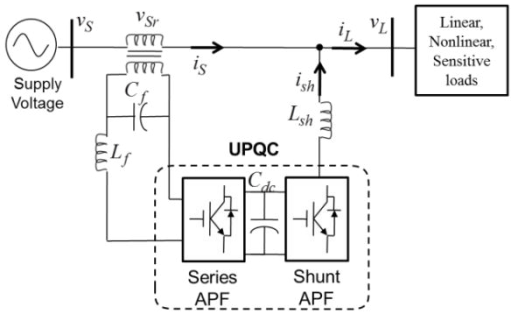

Fig.1. UPQC

II. LITERATURE REVIEW

Here the author presents a comprehensive review on the brought together power quality conditioner (UPQC) to improve the electric power quality at distribution levels. This will be on overview on the different possible UPQC system designs for single-phase (two-wire) and three-phase (three-wire and four-wire) networks, diverse compensation methodologies, and recent developments in this field. It is seen that several researchers have used utilized distinctive names for the UPQC on the unique function, task, application, or topology under consideration.. However, an acronymic list is created and exhibited to feature the recognizing highlight offered by a specific UPQC. In all of the 12 acronyms are listed, in

particular, UPQC-D, UPQC-DG, UPQC-I, UPQC-L, UPQC-MC, UPQC-MD, UPQC-ML, UPQC-P, UPQC-Q, UPQC-R, UPQC-S, and UPQC-VA. In excess of 150 papers on the theme are thoroughly contemplated and fastidiously characterized to classify these acronyms and are discussed in the paper [1]. In this paper the author manages control quality change by utilizing a combination of Passive filters and UPQC in power system. Passive filters are a typical technique to compensate harmonics in reactive power. However they have drawbacks for example, restricted band width, the impacts of system impedance on compensation characteristics. UPQC is a high efficiency solution; cost is high. So in this paper combination of passive filter and UPQC is proposed. The proposed plan can combination voltage unsettling influences and current sounds at the purpose of regular coupling on control circulation networks. Recreation comes about are exhibited to demonstrate the viability of proposed setup [2]. In his paper author introduces a series and parallel active power compensation technique to create the harmonic current references connected to the series control converter in single-phase unified power quality conditioners (UPQC) utilizing multi-level converters ANPC 5 levels. In this proposal, the author selects particular harmonic segments to be suppressed. Moreover, this technique is based on the artificial neural algorithm calculation, and it utilizes the adaline system to figure the synaptic vector of weights. In this specific circumstance, the calculation is mindful to acquire the coefficients of the Fourier series for versatile consonant determination by methods for delta lead, too. To approve the hypothetical advancement, the aftereffects of reenactments are displayed thinking about the utility network with unsettling influences [3]. The power quality issues happens because of the rapid development of nonlinear load leads to sudden reduction of source voltage for few seconds, swell, harmonics and load current, voltage unbalance and so on. These issues can be compensated by utilizing unified power quality controller (UPQC) and the operation of UPQC relies on the accessible voltage at the dc link capacitor. On the off chance that the voltage over the dc connects capacitor is kept up consistent then it gives tasteful execution. The proposed methodology is essentially on planning of Fuel cell system to the dc connect capacitor of UPQC keeping in mind the end goal to keep up the best possible voltage crosswise over it and work the UPQC for control quality analysis. The proposed technique is the putting together the shunt and series active power filter (APF) in the UPQC interconnecting the Fuel cell model/system to the grid in order to get better result. The said display is simulated in MATLAB and results are confirmed by utilizing FFT analysis. In this paper, the simulation model of series, shunt, UPQC and Fuel cell with UPQC is proposed in MATLAB. In case of shunt active filter the "d-q theory" and hysteresis current controller is proposed as its control system and park's transformation is utilized for series active filter with hysteresis voltage controller is proposed as its control strategy [4]. In this paper the author presents, the mathematical analysis of UPQC which is a combination of Shunt-APF and Series-APF in power distribution system. It is more extensive including a series VSC from feeder to feeder. UPQC is included each line originating from different substations to mitigate different power quality issues to keep up great voltage profile at supply side and the load end current unsettling influences in power distribution system. The d-q technique and p-q idea are utilized for controlling of UPQC. Mathematical analysis of UPQC in detail is discussed. In this paper, the UPQC based mathematic approach to deal with moderate all power quality issues has been produced by utilizing MATLAB/Simulink [5]. In this paper the author bring unified power quality conditioner (UPQC) comprises of shunt and series active power filter which acts both on the source side and on the load side for enhancing the power quality. The paper presents strategy for controlling the series filter under unbalanced and mutilated load conditions. The proposed control strategy depends on a three phase locked loop (PLL). For giving a total approach of the UPQC, the control of the shunt filter is also displayed. The entire system is then simulated. The outcomes emphases on one hand a particular beginning method and then again the correction of the power quality on the source side, by looking at the power factor and current THD when utilization of the UPQC. The simulation was performed using Matlab-Simulink condition [6]. The unified power quality conditioner (UPQC) is the most effective method to mitigate with the issue related to PQ especially for the sensitive and users. The author in this paper investigates operation and control of a single phase three-leg UPQC (TL-UPQC), where a novel space vector modulation technique is proposed for naturally solving the coupling issue presented by the basic switching leg. The adjustment strategy is like the notable space vector tweak broadly utilized with three-phase voltage source converters, which consequently conveys additional adaptability to the TL-UPQC system. Two optimized modulation modes with either decreased switching loss or harmonic distortion are examined , so as to show the adaptability brought by the space vector modulated TL-UPQC. Simulations and experimental results are displayed to check the practicality and viability of the proposed space vector balance approach and in addition two modulation modes[7]. In this paper introduces an investigative examination on the effect of unified effect of power-quality conditioner (UPQC) allocation on radial distribution systems. An outline approach for UPQC, called sag based design for phase angle control for (UPQC-SPAC) is proposed. The phase angle shifting of the load voltage required to alleviate a given estimation of voltage drop is resolved and the same is utilized amid a healthy working condition keeping in mind the end goal to give the reactive power compensation of a distribution network. To study the effect of the UPQC-SPAC allocation on distribution networks, it is set at each node, except the substation node , one at a turn. The load flow algorithm for

radial distribution network is reasonably adjusted to consolidate the UPQC-SPAC model. The load flow algorithm comes about demonstrate that a lot of energy reduction, under voltage mitigation, and the upgrade of voltage stability margins can be acquired with a proper situation of the UPQC-SPAC in a circulation arrange. The performance comparison of the UPQC-SPAC with one already revealed plan approach demonstrates that it is more productive in under voltage moderation. A proper allocation of the UPQC-SPAC is also observed to be advantageous for the systems with distributed generation units [8]. The author here describes the use of artificial intelligence is developing quick in the area of power electronics and drives. The artificial neural system (ANN) is considered as another devices to setup control circuitry for power quality (PQ) devices . In this abstract, the ANN - based controller is planned for the present control of the shunt active power filter and trained offline prepared utilizing information from the conventional proportional- integral controller. A digital microcontroller is used for the real time simulation and usage of the control calculation. An exhaustive study is done to explore the execution of the ANN controller and contrast its execution and the traditional PI controller. The system performance is also verified experimentally.[9]. Current electrical energy organizes as smart grids utilizes environmentally friendly power(green energy sources) like wind and sun power. One of the impacts of smart grids on distribution system is good quality control compensation. This paper consider a novel structure for the single phase UPQC-DG (Unified Power Quality conditioner-Distributed Generation) for DC yield DG systems which can be relied on. The proposed design can be utilized for compensation of energy quality issues as well as for providing of load control halfwayIn this drawing, a DG network with low voltage yield is linked with the DC side of UPQC. This converter is designed with one full-connected inverter, one three twisting high compensation transformer and two cyclo-converters to achieve a desired signals with low voltage DG network. High compensation transformer offers up voltage of the fundamental side, lesser the converter sound and also gives an electrical separation between input DG and standard system. Another capacity of the this structure is end of UPQC DC interface capacitor and the large power compensation transformer. State space conditions for methods of the proposed converter are displayed for active investigation and giving legitimate control in light of phase move with nonlinear control. The nonlinear controller depends on Input-Output criticism Linearization to accomplishing some endorsed conduct of the proposed UPQC-DG in moderation of energy quality issues. The execution of the proposed network was examined by means of reenactment with PSCAD/EMTDC investigation program programming. The outcomes are exhibited to affirm the legitimacy of the proposed approach [10]. The current paper proposes a basic power circuit topology for single phase unified power quality conditioner (UPQC). The quantity of energy circuit switches of traditional single-phase UPQC is decreased to half and subsequently it has brought about impressive lessening of cost, weight, volume, assurance circuits, control misfortunes and control circuit unpredictability. The proposed network makes up for the utility voltage harmonics, voltage drop and voltage swell. The proposed circuit could make up for the present harmonics and responsive energy of single-phase non-direct loads. A basic and quick methodology is proposed for the age of pay reference voltage of series active (SAF) and reference compensation current of the parallel active filter (PAF). The specified strategy could direct the voltage of DC side capacitors, as well. The notable hysteresis control technique is utilized for exchanging procedure of PAF. An approximated hysteresis control technique is proposed for exchanging procedure of SAF that makes zero voltage exchanging (ZVS) of its switches conceivable amid turn ON. A circuit demonstrate has been reproduced utilizing PSCAD/EMTDC programming to check the experiment result and to demonstrate the capacity and important active action of the proposed network in the power quality molding of single-phase utility and non-direct loads [11]. This paper exhibits an switching technique for multilevel course inverters, on the basis of the space-vector theory. The proposed switching procedure creates a voltage vector with low harmonics distortion and reduced switching frequency. This new control strategy is an appealing to the classic multilevel phase width regulation methods thinking about the accompanying perspectives: (1) voltage and current total harmonic distortion; (2) range of linear operation; and (3) number of commutations [12]. The capacity of wind generation to stay associated with the network in case of network faults and dynamic reactive power compensation are two parts of grid integration, which have got specific consideration. The wind driven, fixed speed induction generator (FSIG) all alone fails to satisfy these necessities of network mix. The use of unified power quality conditioner (UPQC) to beat the matrix reconciliation issues of the FSIG is explored. The part of the UPQC in upgrading the fault ride-through capacity of the generator is additionally explored under both full and incomplete terminal voltage distortion. A reasonable estimation of the rating prerequisites of UPQC for this kind of utilization is done. A general guideline is displayed to pick the most viable and temperate rating of the UPQC. The execution examination of an UPQC and a static synchronous compensator to help fault ride-through ability of a 2 MW FSIG under Irish grid code requirements has been completed and the UPQC is observed to be more practical in connection to device rating [13]. The brought together power quality conditioner (UPQC) is one of the real custom power seriess, which is equipped for moderating the impact of supply voltage hang at the load end or at the purpose of basic coupling (PCC) in a distributed network. It likewise keeps the spread of the load current harmonics to the utility and enhances the input power factor of the load. The

control of series compensator (SERC) of the UPQC is to such an extent that it infuses voltage in quadrature compensator to the supply current. Along these lines, the SERC expends no active power at steady state. The other proposed advantage of the proposed control scheme is that the SERC can share the lagging VAR demand of the load with the shunt compensator (SHUC) and can ease its loading. The UPQC utilizing this kind of quadrature voltage injection in series is named as UPQC-Q. The VA necessity issues of SERC and SHUCs of an UPQC-Q are discussed. A PC-based new hybrid control has been proposed and the execution of the UPQC-Q is checked in a lab model. The phasor chart, control block graph, simulation and test comes about are exhibited to affirm the validity of the theory [14]. The Unified Power Quality Controller (UPQC) device is a mix of a series active and a shunt active filter. The primary reason for an UPQC is to adjust for voltage flickers/reactive power, and harmonics. It has the capacity of enhancing power quality at point of installation. This paper uses the UPQC to upgrade the low-voltage ride-through (LVRT) ability of the doubly fed induction generator (DFIG)-based wind energy transformation network (WECS) as per the grid association requirement. UPQC is connected to shield the framework from ground faults, permits quick restoring of generation system characteristics, enhances the system power factor, and keep the network from rotor over-current and dc-interface overvoltage [15]. To expand the compensation capacity of unified power quality conditioner (UPQC) and suppress the grid current change at the time of power regulation, a sort of enhanced UPQC topological structure is proposed. With focal points of high power density, large electrostatic limit and long cycle life, super capacitors are combined with bidirectional DC/DC converter to create the energy storage system in parallel with DC-link to keep DC voltage steady and to be utilized additionally as an extra UPS. Low frequency mathematical model of the conditioner under dq arranges in light of state-space strategy is constructed and non-PLL compensation identifying technique is connected. Moreover, both the control methodology of voltage and current pay and vitality administration plans of super capacitors are given. This structure gives another fitting method to UPQC and reenactment comes about show obviously the possibility [16]. In this paper the author manages another active model of synchronous-reference-frame (SRF)- based control in three phase network under various load contemplations to enhance control quality by utilizing power conditioner with multi converters. The proposed MCUPQC network can control the load voltages on Parallel power distribution system under balanced and distorted load conditions and acquire the state space model for MC-UPQC. The simulation results to help the SRF-based control technique displayed in this paper is finished utilizing Matlab/Simulink[17]. This paper displays an investigative study on unified power quality conditioner (UPQC) allotment for reactive power compensation of radial distribution systems. An UPQC comprises of an series and a shunt inverter. The UPQC demonstrate in light based on phase angle control (UPQC-PAC) is utilized. In UPQC-PAC, the series inverter infuses a voltage with controllable phase angle such that the voltage magnitude at load end stays unaltered. Attributable to the phase angle shift, the series inverter takes an interest in load reactive power compensation of the distribution network. The UPQC-PAC mode is reasonably changed in order to give the reactive power compensation of a distribution network. The effect of the UPQC-PAC distribution is examined by setting it at each bus of a system, aside from the substation bus, one at a time. A load flow algorithm including the UPQC-PAC display is model and utilized as a part of the assurance of its optimal location in a network. The simulation study demonstrates that the optimal distribution of UPQC-PAC results about significance measure of power loss reduction, under voltage mitigation, and upgrade of voltage stability margin. Better power loss and bus voltage are obtained with UPQC-PAC compared and with some [18]. This paper shows partial swarm optimization (PSO) - based multi-target arranging calculation for reactive power compensation of radial distribution systems with unified power quality conditioner (UPQC) distribution. A UPQC comprises of a series and a shunt inverter. The UPQC model based on phase angle control (UPQC-PAC) is utilized. In UPQC-PAC, the series inverter infuses a voltage with controllable phase angle in a way that the load end stays unaltered. Because of the phase angle shift, the series inverter participates in reactive power compensation along the shunt inverter during working condition. In the proposed approach, the optimal location, the reactive power compensation required at the location, and the ideal outline parameters of UPQC are controlled by limiting three target: (1) the rating of UPQC, (2) network power loss, and (3) percentage of node with undervoltage issue. These targets are all the while limited to acquire an series of non-dominated solution utilizing multi-objective PSO (MOPSO). The performance of two MOPSO variants are compared at and the better one is utilized as a part of study. A load flow algorithm including the UPQC-PAC show is devised. The execution of the proposed algorithm is approved with various analyses [19]. The author presents another idea of usage of a unified power quality conditioner (UPQC). The series inverter of UPQC is controlled to perform simultaneous 1) voltage sag/swell compensation and 2) load reactive power sharing with the shunt inverter. The active power control approach is utilized to compensative voltage sag/swell and is integrated with theory of power control (PAC) of UPQC to organize the load reactive power, between the two inverters. Since the series inverter at the same time conveys active and reactive power, this idea is named as UPQC-S (S for complex power). A point to point mathematical analysis, to extend the PAC approach for UPQC-S, is displayed in this paper. MATLAB/SIMULINK-based simulation results are also discussed. At last, the proposed idea is approved with a digital

signal processor-based experimental study [20]. As of now, the nature of provided control is essential for several customers. Power quality (PQ) is a service and many customers are prepared to pay for it. In coming time, distribution system operators could choose, or could be obliged by experts, to supply their customers with different PQ levels and at various costs. Another gadget that can satisfy this part is the OPEN unified power-quality conditioner (UPQC), made out of a power-electronic series steady state performance main unit introduced in the medium-voltage/low-voltage (LV) substation, alongside a few power-electronic shunt units associated near the end users. The series and parallel units don't have a typical dc interface, so their control systems are unique in relation to traditional UPQC control strategies. This device can accomplish general change in PQ, decreasing the most widely recognized unsettling influences for all customers that are provided by the mains (PQ) by utilizing just the series unit. Extra additions in PQ (i.e., mains control intrusions), can be given to the customer who require it (custom power) by the shunt units. Consequently, this new series joins a change in PQ for all end customers, with a cost lessening for those that need high quality power. The proposed solution has been examined and described, and a model of a 400-kVA LV grid is viewed as a test network to evaluate the steady state execution and functioning units. The result got under steady state conditions justify the series chosen and good device performance [21]. This paper exhibits another unified power-quality molding system (MC-UPQC), fit for synchronous compensation for voltage and current in multibus/multifeeder system. In this setup, one shunt voltage-source converter (shunt VSC) and at least two or more series VSCs exist. The system can be connected to neighboring feeders to adjust for supply-voltage and load current imperfection on the principle feeder and full compensation of supply-voltage imperfections on alternate feeders. In the proposed setup, all converters are connected back to back on the DC side and offer a typical DC-interface capacitor. Along these lines, power can be exchanged from one feeder to nearby feeders to adjust for sag/swell and interruption. The execution of the MC-UPQC and also the embraced control calculation is represented by simulation. The result obtained in PSCAD/EMTDC on a two-bus/two-feeder system demonstrates the effectiveness of the proposed design [22]. The power quality issues occurs because of the rapid development of nonlinear load leads to sudden decline of source voltage for a couple of moments i.e. sag, swell, harmonics in source and load current, voltage unbalance and so on. Every one of these issues can be repaid by utilizing brought together power quality controller (UPQC) and the activity of UPQC relies on the accessible voltage at the dc interface capacitor. If the voltage across the result dc link capacitor is kept up constant then it gives good results. The proposed scheme is fundamentally on designing of Fuel cell sustained to the dc link capacitor of UPQC keeping in mind the end goal to keep up the correct voltage across it and operate the UPQC for control quality analysis. The proposed technique is the gathering of shunt and series active power filter (APF) in the UPQC interconnecting the Fuel cell system to the grid for better results. The stated demonstrate is simulated in MATLAB and results are confirmed by utilizing FFT analysis. In this paper, the simulation model of series, shunt, UPQC and Fuel cell with UPQC are designed in MATLAB. If there should be an occurrence of shunt active filter the "d-q theory" and hysteresis current controller is proposed as its control method and transformation is used for series active filter with hysteresis voltage controller is proposed as its control method [23].In this paper unified power quality conditioner (UPQC) has turned into the most alluring to enhance the power quality (PQ) in the microgrids. However, the high assembling cost is an immense test of promoting the UPQC network. This paper researches the ideal size of the UPQC system in view of the compensation requirements. A generalized strategy is proposed to upgrade the measure of the UPQC system, which decides the fundamental ratings of the shunt converter, series converter, and series transformer. An data driven control (DDC) based controller is produced utilizing the variable phase angle control (PAC) technique to understand the execution of the outlined UPQC system under the different compensation conditions. Additionally, the MATLAB and OPAL-RT simulation results about to approve the practicability of the generalized strategy and the DDC based controller [24]. Author in this paper displays a novel and simple to execute control methodology for unified power quality conditioner (UPQC). This control methodology is usable in three-phase three-wire utilities. The control system of parallel active filter (PAF) depends on mixture of extended p-q theory and instantaneous symmetrical components theory while the control circuit of series active filter (SAF) depends on instantaneous symmetrical components theory. The problem of generally three phase imbalance reference streams of current extended p-q theory has been solved. Performance of PAF utilizing this strategy compensates for reactive power, current harmonics and unbalanced currents while task of SAF makes up for voltage imbalance and voltage harmonics. The task of control circuit is expanded utilizing analytical analysis. The validity of activity of control technique is considered through simulation about [25]. In this paper, the mathematical Analysis of UPQC which is combination of Shunt-APF and Series-APF is being discussed in distribution power system. It is more expanded by including an series VSC from feeder to feeder. UPQC is included each line originating from various substations to mitigate distinctive power quality issues to maintain good voltage profile at supply side and the load end current disturbance in distribution power system. The d-q ------- and p-q concept are utilized for controlling of UPQC. Mathematical analysis of UPQC in detail is briefly discussed. In this paper, the UPQC based mathematical approach to mitigate all power quality issues has been developed by using

MATLAB/Simulink [26]. Here in this paper a power converter topology where a Unified Power Quality Conditioner (UPQC) is joined with the photovoltaic generators is displayed. This topology depends on a double structure of the established three-phase two level inverters. Accordingly, multilevel task is accomplished with the upsides of this sort of inverters. Another element of this structure is the higher dependability of the consolidated system. Actually, even with blame in one of the inverters the system can at present work. Voltage and current controllers are likewise depicted. The current and voltage controllers are executed in the synchronous pivoting reference outline (dq0-hub). A few outcomes are exhibited with a specific end goal to confirm the activity of the system under different conditions [27]. This paper exhibits the execution investigation of a solitary phase UPQC (unified power quality conditioner) device with a left shunt APF (active power filter) series, named as left shunt UPQC. This device is connected for an extraordinary load setup. One series of load is voltage touchy with significant reactive power compensation. The other set comprise of load which is very unaffected by voltage unsettling influences yet present high symphonious substance in the source current. A PAC (passive active control) idea amongst series and shunt APF parts of UPQC with break even with reactive power sharing methodology is additionally executed with the controller to level VA appraisals of the two APFs. Likewise variety in evaluations of the left shunt UPQC is contrasted and a correct shunt UPQC with same load series and distinctive source voltage condition. The execution investigation of left shunt UPQC is examined in MATLAB/SIMULINK and OPAL-RT as far as various execution parameters, for example, voltage drop compensation, current harmonics compensation and reactive power compensation [28]. Unified power quality conditioner (UPQC) comprises of shunt and series active power filter for enhancing both the power quality on the source side and on the load side. The paper shows a straightforward technique for controlling the series filter under unbalanced and distorted load conditions by utilizing a three phase locked loop (PLL). Two strategies for controlling the shunt filter are analyzed. The model of the whole system is introduced and consideration on the starting system is highlighted. The simulator is performed by utilizing the Matlab-Simulink condition. The improvements of the power quality are examined by comparing at the THD on the source side before and after use UPQC [29]. Distributed energy resources (DERs) are vital because of the increasing interest of electrical energy and exhaustion of fossil fuels. At the point when DERs are put in the dissemination network, different power quality issues emerge including voltage unbalances and current sounds. These issues emerge because of the excess power which is sustained back to the system when age in a specific phase surpasses stack request inferable from the nearness of DERs. The paper proposes the use of shunt active power filter (SAPF) and unified power quality conditioner (UPQC) to reduce the power quality issues. SAPF is in action during the normal conditions yet when an unbalance is available in the network, undesirable impacts are noticed. These issues can be resolved utilizing UPQC. The network with DER and SAPF/UPQC has been displayed modeled MATLAB and the performance analysis of SAPF and UPQC is done and thought compared [30]. In recent times, the nature of power has turned out to be more critical to the vast majority of the customer load. The unified power quality conditioner (UPQC) is a best solution to all such energy quality issues. The UPQC can enhance the nature of energy for all end customers, yet it won't give the power quality at various request levels. Another topology Open UPQC being more adaptable for field application as the power quality is controlled by the power bills of the clients. In this paper, the both the topologies are created in the MATLAB/Simulink condition and broke down the execution with non-direct loads and distinctive kinds of voltage droops in the network [31]. The author talks about the significance of UPQC in the power quality change of the appropriation network with non direct load. The bound together power quality conditioner (UPQC) is a power molding gadget, which is a mix of consecutive associated shunt dynamic power channel and series dynamic channel with a typical DC interface voltage. To decrease of energy quality (PQ) issues in a circulation network; a dynamic model of the UPQC is created in the MATLAB/SIMULINK condition and the reproduction comes about exhibiting the power quality change in the network are introduced for contorted supply and a mix of straight and non-direct load [32]. Power quality in circulation networks is as of now a worry in numerous European Countries where there is a solid nearness of sustainable power source age. There is in this way a developing enthusiasm for new innovations ready to enhance the power quality level, among them the Open Uninterruptible Power Quality Conditioner (Open UPQC). Notwithstanding a few recommendations have been investigated in writing, there is as yet couple of cases of experimentation in genuine conditions. The paper examines the plan and the reenactment of the Open UPQC, concentrating on its series part. This examination is the aftereffect of the preparatory examination lead before the physical establishment of the network in a genuine working dissemination matrix [33]. A propelled control approach for control quality pay utilizing Unified Power Quality Conditioner (UPQC) is exhibited in this paper. This approach has ability of voltage bending alleviation and current sounds compensation. In the UPQC control, Series Active Filter (SAF) is controlled by d-q-o approach for voltage symphonious pay. Voltage flag figured at SAF is utilized for count of required reference signals utilizing P-Q hypothesis for Parallel Active Filter (PAF) control for current consonant pay. This control technique requires diminished number of estimations (source voltage and load current). Reenactment comes about demonstrate the approval of proposed technique [34]. This paper proposes an improved control methodology for

three-phase unified power quality conditioners (UPQCs) under the mutilated source and nonlinear load conditions. The proposed controller comprises of a relative indispensable and a dull controller (RC), which is created on both the series and the shunt APFs of the UPQC to adjust (6n±1) (n=1, 2, 3...) harmonic voltages in distorted source voltage and those harmonic currents produced by nonlinear loads. Accordingly, the load voltage and the supply current are compensated to the sinusoidal. In the proposed RC, the delay time is reduced to be one-sixth of the fundamental period which is substantially shorter than that of the traditional RC, i.e., one fundamental period. Thus, the proposed RC gives a substantially quicker powerful reaction contrasted with the customary RC. The proposed control system is broke down and plan of the RC for the UPQC is exhibited in detail [35].

TABLE I. COMPARATIVE ANALYSIS OF DIFFERENT PROPOSED TECHNIQUES IN DIFFERENT SUPPLY SYSTEM

Ref. No.	Authors	Title	Results/Conclusions
1	V. Khadkikar (2012)	Enhancing Electric Power Quality Using UPQC: A Comprehensive Overview	With the help of UPQC it has become possible to maintain the quality of electric power within the acceptable limits.
2	A. R. Naderipour (2010)	Voltage and current compensation in dispersed generation systems	A hybrid solution was proposed to compensate voltage and current in the power system using UPQC. Filter costs are decreased.
3	R. Barriviera, E. J. Acordi and R. Q. Machado (2017)	Selective compensation of harmonics applied in a multilevel single-phase UPQC system	Quality of electric power improved with the help of single phase UPQC system.
4	S. Samal, P. K. Hota and P. K. Barik (2017)	Fuel cell integrated UPQC System for power quality improvement	UPQC maintains constant voltage of 700V when Sag, Swell and Interruption occur.Model is simulated in MATLAB and results are verified by using FFT analysis.
5	D. Krishna, M. Sasikala and V. Ganesh (2017)	Mathematical modeling and simulation of UPQC in distributed power systems	Voltage and current harmonics have been reduced by introduction of UPQC.
6	S. Ivanov, M. Ciontu, D. Sacerdotianu and A. Radu (2017)	Simple control strategy of the series filter within a unified power quality conditioner	Introduced a method for controlling the series filter under unbalanced and distorted load conditions which is based on a three phase locked loop (PLL).
7	Y. Lu, G. Xiao, X. Wang, F. Blaabjerg and D. Lu (2016)	Control Strategy for Single-Phase Transformerless Three-Leg Unified Power Quality Conditioner Based on Space Vector Modulation	Two optimized modulation modes with either reduced switching loss or harmonic distortion are derived, evaluated and discussed.
8	S. Ganguly (2014)	Impact of Unified Power-Quality Conditioner Allocation on Line Loading, Losses, and Voltage Stability of Radial Distribution Systems	Power-loss reduced,under voltage mitigation, and the enhancement of voltage stability margin obtained with UPQC-SPAC in a distribution network and it is more efficient in undervoltage mitigation.
9	V. G. Kinhal, P. Agarwal and H. O. Gupta (2011)	Performance Investigation of Neural-Network-Based Unified Power-Quality Conditioner	With the use of ANN controller there was considerable improvement in the response time of the control of the dc-link current.
10	A. Mokhtarpour, M. Bathaee, H. A. Shayanfar (2012)	Power quality compensation in smart grids with a single phase UPQC-DG	UPQC-DG is used to compensate power quality problems as well as supplying of load power partly. UPQC DC link capacitor and the bulky power frequency transformer are eliminated in this configuration.
11	S. A. O. da Silva and F. A. Negrão (2018)	Single-Phase to Three-Phase Unified Power Quality Conditioner Applied in Single-Wire Earth Return Electric Power Distribution Grids	The good static and dynamic behavior of the UPQC-1Ph-to-3Ph has been proven. System also able to suppress grid voltage harmonics and voltage sags.
12	J. Rodriguez, L. Moran, P. Correa and C. Silva (2002)	A vector control technique for medium-voltage multilevel inverters	It generates voltage vector with very low harmonic distortion and reduced switching frequency. Also it has better performance than carrier-based PWM methods
13	N. G. Jayanti, M. Basu, M. F. Conlon and K. Gaughan (2009)	Rating requirements of the unified power quality conditioner to integrate the fixedspeed induction generator-type wind generation to the grid	UPQC is found to be more economical in relation to device rating. 100% real power transfer for lower sag levels.

14	M. Basu, S. P. Das and G. K. Dubey (2008)	Investigation on the performance of UPQC-Q for voltage sag mitigation and power quality improvement at a critical load point	For a long duration under-voltage the VA consumption of the UPQC-Q is minimal. It is also capable of maintaining harmonic isolation between utility and load.
15	M. A. Saleh, M. N. Eskander, S. Amer and M. N. F. Nashed (2014)	Enhancing the LVRT capability of grid connected wind energy conversion system using Unified Power Quality Controller	The results revealed the fast recovery of stator, rotor, and dc link currents to their steady state values. Results ensured the superior performance of WECS.
16	Z. Hailiang, W. Jianru, Y. Chenhu and L. Shuchao (2011)	Analytical research on unified power quality conditioner based on super capacitors energy storage system	The control strategy of voltage and current compensation and energy management schemes of super capacitors are given.
17	P. V. Naidu and B. Basavaraja (2012)	Design of a SRF based MC UPQC used for load voltage control in Parallel distribution systems	The performance of the SRF based MC-UPQC is tested under various disturbance conditions. The power quality is improved in three phase system under different load considerations.
18	S. Ganguly (2014)	Unified power quality conditioner allocation for reactive power compensation of radial distribution networks	The optimal allocation of UPQC-PAC results to significant amount of power loss reduction, under voltage mitigation, and enhancement of voltage stability margin.
19	S. Ganguly (2014)	Multi-Objective Planning for Reactive Power Compensation of Radial Distribution Networks With Unified Power Quality Conditioner Allocation Using Particle Swarm Optimization	A load flow algorithm including the UPQC-PAC model is devised. The performance of the proposed algorithm is validated with different case studies.
20	V. Khadkikar and A. Chandra (2011)	UPQC-S: A Novel Concept of Simultaneous Voltage Sag/Swell and Load Reactive Power Compensations Utilizing Series Inverter of UPQC	The significant advantages of UPQC-S over general UPQC applications are: 1) the multifunctionability of series inverter to compensate voltage variation 2) better utilization of series inverter rating of UPQC; and 3) reduction in the shunt inverter rating.
21	M. Brenna, R. Faranda and E. Tironi (2009)	A New Proposal for Power Quality and Custom Power Improvement: OPEN UPQC	OPEN UPQC can significantly improvethepowerquality, and cost reduction for those that need high quality power with a good device performance.
22	H. R. Mohammadi, A. Y. Varjani and H. Mokhtari (2009)	Multiconverter Unified Power-Quality Conditioning System: MC-UPQC	MC-UPQC is capable of fully protecting critical and sensitive loads against distortions, sags/swell,and interruption in two-feeder systems, and compensation for interruptions without the need for a battery storage system.
23	] S. Samal, P. K. Hota and P. K. Barik (2017)	Fuel cell integrated UPQC System for power quality improvement	Fuel cell -UPQC maintains constant voltage of 700V when Sag, Swell and Interruption occur.
24	J. Ye and H. BengGooi (2017)	Optimization of the size of UPQC system based on data-driven control design	Data-driven control (DDC) based controller is developed using the variable phase angle control (PAC) method which enhances overall power quality in UPQC system.
25	M. T. Haque, T. Ise and S. H. Hosseini (2002)	A novel control strategy for unified power quality conditioner (UPQC)	The problem of generating three phase imbalance reference currents of extended p-q theory has been solved. The validity of operation of control strategy is studied through simulation results.
26	D. Krishna, M. Sasikala and V. Ganesh (2017)	Mathematical modeling and simulation of UPQC in distributed power systems	This paper has introduced UPQC to reduce voltage and current harmonics.By adding the number of APFs from feeder to feeder the advanced UPQC can achieve various mitigating techniques.
27	S. Devassy and B. Singh (2017)	Control of solar photovoltaic integrated UPQC operating in polluted utility conditions	SPV-UPQC allows good accuracy in extraction of fundamental component of load current without sacrificing the dynamic performance.The load voltage and grid current harmonics have been maintained within limits given in IEEE-519 standard.
28	N. Patnaik, A. K. Panda and P. R. Mohanty (2016)	Performance and comparative rating evaluation of single phase left shunt	Left shunt UPQC system rating is much less as compared to a right shunt UPQC system. Also, the

		UPQC	left shunt UPQC performance is analyzed subsequently with MATLAB/SIMULINK and real time digital simulator (OPAL-RT).
29	S. Ivanov, M. Ciontu, D. Sacerdotianu and A. Radu (2017)	Simple control strategies of the active filters within a unified power quality conditioner (UPQC)	The improvements of the power quality are analyzed by comparing the THD on the source side before and after use of the UPQC.
30	P. K. Nair and P. Reji (2015)	Power quality improvement in distribution networks containing distributed energy resources using unified power quality conditioner	Eliminates harmonics to a greater extent, mitigates the voltage unbalance problems when a disturbance occurs in the system.
31	J. Kotturu and P. Agarwal (2015)	Comparative performance analysis of UPQC and Open UPQC	Open UPQC can possess the better compensating characteristics than the conventional UPQC topology for both steady state and transient conditions of system disturbances.
32	A. Shrivastava and P. Nene (2015)	Power Quality Enhancement Using UPQC connected with PV Arrays	Results obtained show the effectiveness of the UPQC. The THD level of the system from 21.40% is reduced to 5.25%.
33	G. D'Antona, R. Faranda, H. Hafezi, G. Accetta and D. Della Giustina (2014)	Open UPQC: A possible solution for power quality. Series unit analysis	Series unit control logic is presented and several simulations in presence of three different power quality problems are issued.The designed system will be tested in a real distribution grid.
34	K. H. Kwan, K. T. Tan, P. L. So and K. H. Kwan (2012)	An unified power quality conditioner for load sharing and power quality improvement	The proposed hybrid system is generic in nature and can be used with other UPQCs to enhance their performance and capabilities. This system is an effective method to handle PQ problems as well as to act as a cleaner energy source.
35	Q. N. Trinh and H. H. Lee (2012)	A repetitive control scheme to improve performance of UPQC under distorted source and nonlinear load conditions	The proposed RC provides a much faster dynamic response compared to the traditional RC and excellent steady-state performance as well as very fast dynamic responses against load variations.

III. CONCLUSION

This paper presented a literature review about the different methods to mitigate power related issues like voltage swell/sag and reduction of harmonics. The documented papers present the use of unified power quality conditioner (UPQC) to mitigate simultaneously issues of voltage and current relate related problems in the power system. UPQC makes use of series and shunt active filters, where series active filter is used to meet the voltage related issues and shunt active filter is used to meet the current related issues.

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