POWER QUALITY IMPROVEMENT OF DISTRIBUTED POWER SYSTEM NETWORKS

CHENNURU DHANUNJAYA[1], V.BRAHMAIAH[2], K.T.PRASANTHI[3], V. SURYA PRAKASH[4]

***ABSTRACT:** In this paper, another force quality rundown (PQI), which is straightforwardly related to the time of contortion power from nonlinear symphonious burdens, is acquainted with choose their consonant pollution situating in a dispersal power framework. The electric burden sythesis rate (LCR) and indisputably the symphonious bending (THD) for the surveyed by the decreased multivariate polynomial (RMP) model with a solitary shot getting ready property. Then, at that point, the situating of mutilation power for each nonlinear burden, which has threatening impact in general framework, is settled. The situating demonstrates how much unfavorable outcome each nonlinear burden has on purpose for normal coupling concerning mutilation power. It viability and authenticity are affirmed the by the reenactment results. The symphonious current infusion model based time-space amusements are done to show the adequacy of the proposed PQI under different conditions with different nonlinear burdens.*

The proposed PQI as a viable gadget for noticing and dealing with the force quality in movement framework similarly as in a home. The utilization of proposed PQI to the homegrown scattering power network is used for execution of the sharp lattice.

1. INTRODUCTION

Power Quality is depicted by limits that express harmonic contamination, reactive power and load unbalance. The best conceivable reactions for these issues are inspected and their control structures are elucidated. Plans shows in the field are clarified and field results are exhibited. It is exhibited that by utilizing the right improvement a hodgepodge of Power Quality issues can be perceived conveying establishments inconvenience free and more proficient, and can convey them charming with even the strictest necessities.

The power quality (PQ) in modern power systems has become a significant issue for both power suppliers and consumers. The real PQ plans will be necessary at each physical location where ownership is moved. Therefore, cultivate the fitting power quality document (PQI) similarly as character the sources and disturbances deteriorating the PQ. This project deals with the new power quality record (PQI) based on Euclidean standard method. Power Quality is directly related to the distortion power which is generated from nonlinear loads. By dealing with the performance of the past PQI, it is used to apply for a practical dispersal power system association. The proposed power quality document (PQI) was outlined as a combination of two factors. They are the Euclidean standard of full scale harmonic distortions (THDs) the electrical load composition rate (LCR) in assessed voltage and current waveforms.

Electrical devices are getting delicate to power quality distortions because of the development of electronics. An electronic controller which has the size of a shoebox can efficiently control the performance of a 1000-hp motor, whereas the motor might be somehow protected to power quality issues, the controller are not. Which we have a motor system which is very touchy to power quality is the complete effect. Occasionally electrical equipment gives its own power quality issues.

To achieve strong and consistent performance without respect to some random conditions, this project proposes the new distortion power quality record consisting of the electrical load composition rate (LCR) surveyed by the reduced multivariate polynomial (RMP) model and the Euclidean standard of THDs of the purposeful voltage and current waveforms. The proposed gives the general harmonic contamination situating (HPR) of each nonlinear load in the existence of misshaped voltage at PCC.

2. EXISTING SYSTEM

Because of Power quality issues a wide scope of disturbances like voltage expands/hangs, flicker, harmonics, distortion, drive homeless individuals and interruptions are occurred. Voltage develops are not as significant as voltage hangs because they are more surprising in scattering systems. Voltage swell and hang can cause touchy equipment to fail or shut down, similarly as create a huge current unbalance that could blow trip breakers or circuits. These effects can be excessive for the customers, going from minor quality assortments to production individual time and equipment harm. Voltage hangs can occur at any snapshot of time, with abundancy going from 10-90 % and range continuing for half a cycle to one second .Voltage swell, then again is characterized as swell is characterized as an increase in rms voltage or current at power frequency for terms from 0.5 cycles to one second. The typical voltage injection capability of a DVR is in the scope of half. Hence, to compensate for harmonics as low as 1% (or lower) the system should work at guideline depths of around 2% however high significance and phase accuracy should regardless be stayed aware of for the compensation to be effective. Recent work has proposed a feed-forward approach for voltage harmonic compensation that furthermore accounts for the model deferral and voltage drop across the filter inductance. There are different methods to calm voltage hangs and expands yet the use of a custom power device is considered to be the most efficient method. Various custom power controllers have effectively been discussed with touchy loads under abnormal conditions. Countless these power controller devices we have discussed beneath to think about the voltage quality to the extent hang, expands and flickers and to chip away at quality of current at utility end with the help of their configurations and working principles. To tackle this issue, custom power devices are used using MATLAB for static and dynamic load conditions

Power quality (PQ) disturbances, such as voltage hang and harmonic distortion, have increased in the past couple of decades. Such disturbances might shift significantly depending upon the location. Therefore, the most convenient response for lighten PQ disturbances and to protect touchy equipment is to introduce genuine kinds of custom power devices (CPDs) such as the Distribution Static Synchronous Compensator (D-STATCOM) carefully computed using a fitting enhancement process, to meet the technical and economic requirements. In the earlier decades, different improvement techniques have been created and applied to address the best placement and assessing issues of CPDs in power systems. A genetic algorithm (GA)- based enhancement technique to place a dynamic voltage restorer (DVR) and a thyristor voltage controller (TVR) to restrict the voltage hang effect in a winding circulation system. GA in the placement of versatile pivoting current transmission system (FACTS) devices to further foster the hang performance of transmission systems. An inching GA with better search performance has furthermore been created to mitigate voltage hang using the FACTS devices. The gravitational search algorithm has been applied to further foster the hang performance of a power system using the best placement of the D-STATCOM. Other devices, such as appropriated generators (DGs) and capacitor banks, have also been considered to preferably further foster the voltage profile of the system using particle swarm smoothing out (PSO) similarly as combined GA and PSO. The firefly algorithm (FA)- based enhancement technique is applied to decide the best size and location of the D-STATCOM to chip away at the PQ of a system. In the proposed advancement algorithm, the voltage harmonic distortion, voltage deviation, and hard and fast endeavor cost indices are considered as the sub-objective functions, and quite far and D-STATCOM capacity limits are considered as constraints of the control factors. The performance of the proposed method is assessed on winding IEEE 16 and 34-bus test systems using Matlab programming. The FA results are compared with those acquired from the PSO and the GA.

As the increased utilization of power electronic devices and nonlinear loads upsets the distortion in voltage and current waveforms, the power quality (PQ) in modern power systems have become a significant issue for both power suppliers and consumers.

Likewise, there has been an increasing example towards electric freedom and free power producers (IPPs) based on economical power sources such as energy component, photovoltaic, wind, and gas-fuelled micro-turbines, etc. Furthermore, the scattered age (DG) by the IPP with ineffectively controlled synchronization will make it more difficult to handle the PQ issues related with system trustworthiness and adequacy at both power age and circulation levels. In other words, electricity has been generally sold from on supplier to one consumer with ownership changing hands at simply a single physical point the income meter. In contrast, after freedom accompanied with the DGs, it is expected that the ownership of electric power will be exchanged at a couple focuses along the age transmission-circulation chains. Then, the proper PQ plans will be necessary at each physical location where ownership is moved. Therefore, encourage the legitimate power quality rundown (PQI) similarly as character the sources and disturbances debilitating the PQ.

The cutoff focuses on the proportion of harmonic current and voltages generated by customers and/or utilities have been established in the IEEE standards 519 and 1547, and in the IEC-61000-3 standard. Recently, a couple of techniques to achieve the specified levels of PQ while enhancing its performance have been accounted for. Moreover, a couple of power quality indices through the examination of assessed voltage and current waveforms and analytical contraptions to survey the harmonic contributions on a condition of common coupling (PCC) have been created.

In particular, the distortion power quality record (DPQI), which accounts for the direct relationship between distortion power and harmonic components of nonlinear loads. It complements the restriction of all out harmonic distortion (THD) illuminating the distortion regarding any typical waveforms by addressing the different effect of contaminated loads on a PC

3. PROPOSED SYSTEM

The as a rule procedure to execute the is shown in Fig.1 There are two sections, one is to simply to calculate their THDs of the purposeful current and voltage and the other is check the LCR by using the RMP model, based on the Parseval's theorem. In Fig.4.5.1, the left movement of Figure shows how to assess the LCR by applying the RMP model. Meanwhile predicted by the RMP model when the voltage at the PCC, is anything however a totally sinusoidal waveform, the right stream shows how to calculate the THD for the nonlinear load harmonics. Generally, it has slight harmonics in practice.

Decide the proper solicitation when the RMP model is applied to evaluate the LCR. In a physical application in the existence of commotion and/or complex correlations among the various nonlinear harmonic loads, the for the most part high-solicitation of RMP model might be unmistakably used to enhance appraisal accuracy. However, the appraisal process by exceptionally high-demand RMP models requires expansive computations and memory dynamically activity. In like manner, its weight-course of action vector intending to high estimation is hard to separate.

Also, it's anything but a fact that the high-demand RMP model consistently beats the moderately low-demand RMP model. There is no firm response for selecting its optimal solicitation. By a couple of tests, the sixth-demand RMP model is obviously selected to evaluate the LCR in this project.

Meanwhile, the appraisal of nonlinear load harmonics, which was expected to execute the DPQI¬¬¬old, isn't necessary here for calculating the THD of waveforms. Therefore, it make an effort not to apply another RMP model. This makes the execution of DPQI¬¬¬new more efficient and effective for use in practice. The overall procedure will be as shown in fig.4.5.1.

From the overall procedure we can conclude that the DPQI¬¬¬new device for advancement of distortion power in scattered power grids.In circulated power grids distortion power quality record can be improved by DPQI¬¬¬new. The evaluation process by incredibly high-demand RMP models requires expansive computations and memory. The evaluation of nonlinear load harmonics isn't necessary here for calculating the THD of waveforms.

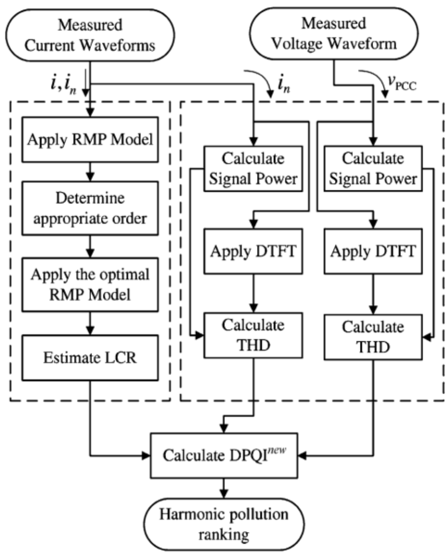

Fig.1 Overall procedure to implement the DPQI.

Harmonic pollution ranking can be done by the above procedure. it avoids applying another RMP model. This makes the implementation of DPQI^{new} more efficient and effective for use in practice.

4. SIMULATION RESULTS

Simulink model for calculating for new power quality index:

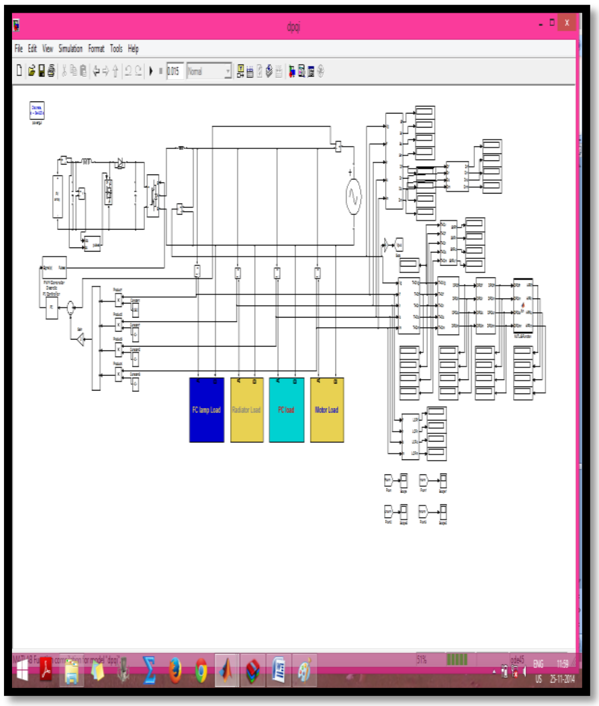

Fig 2 Proposed DPQI model

The voltage V_{PCC}(t), and the total electric load current i(t),at the PCC in Fig.2 are measured simultaneously during one period T of the fundamental. It is shown from Fig. 3 that is lagging and that both are slightly distorted.

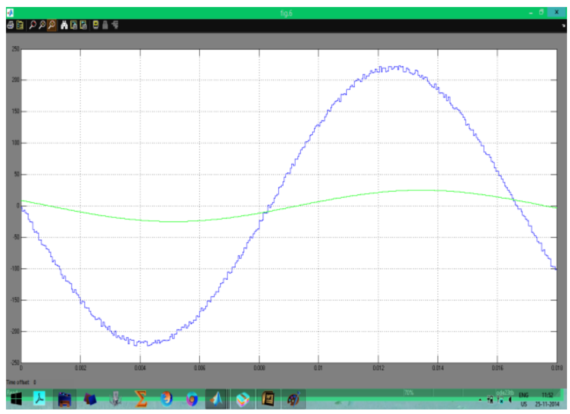

Fig 5.3.4 the voltage V_{PCC} (t), and the total electric load current i(t), at the PCC during one period of the fundamental.

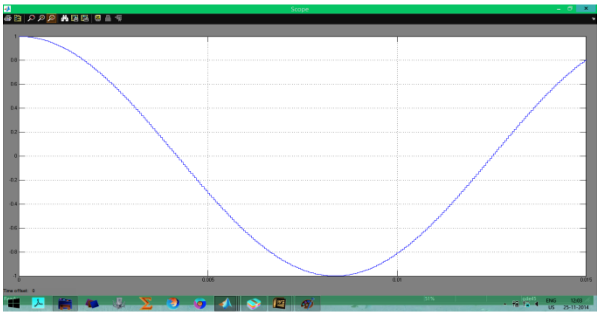

Fig. 3 Normalized load currents of i_f during one period of the fundamental.

The normalized load current of fluorescent lamp will be as shown above .the data from the above fig 5.3.5 can be used for calculating the Harmonic Pollution Ranking.

The fig.4 shows the load current wave form for radiator. This curve will be drawn between load current and time.

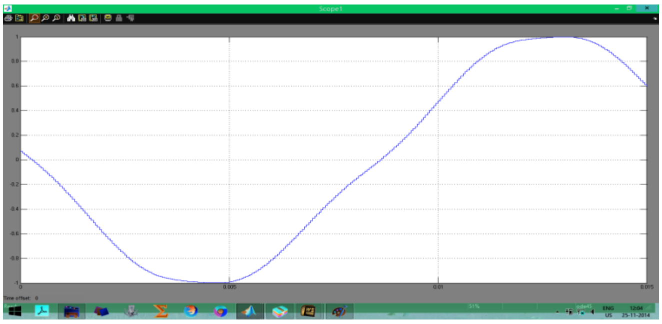

Fig. 4 Normalized load currents of i_r during one period of the fundamental.

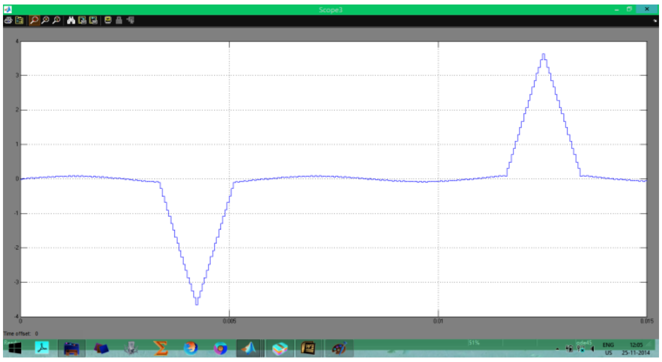

Fig. 5 Normalized load currents of ic during one period of the fundamental.

The fig 5 shows the normalized load current of computer for a period of time. This data can be utilised for calculating HPR and LCR.

All load currents i_f , i_r, i_c and i_m are measured, and their normalized waveforms with respect to their own fundamental components are shown in above figures.

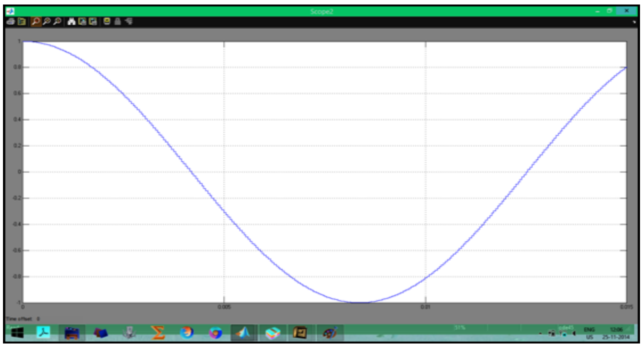

Fig. 6 Normalized load currents of i_m during one period of the fundamental.

Again, all load currents the degree of their distortion is more severe than i(t) lagging V_{PCC} (t). Each load current waveform (normalized) and the harmonics of V_{PCC} (t) are calculated by using discrete-time-Fourier-transform (DTFT).The sampling frequency of all obtained waveforms is 500,000 Hz in this Fourier analysis, which is high enough to satisfy the Nyquist theorem with respect to the other high-frequency0 (up to 20th-order) components as well as the fundamental.

Table 1 THDs of PCC voltage and load currents

Load type	Fluore scent	Radiato r	Compute r	Moto r
THD(V_{PCC}) [%]	3.78			
THD(i)[%]	11.7	4	145.4	5.33

With the information in above figures THDs of the PCC voltage and load currents are calculated, according to the meaning of THD.

It is seen that the PCC voltage is twisted with the little THD of 3.78%, which is sensibly acceptable, from the results in Table 5.1.

All nonlinear loads are affected by the distortion from and therefore have more harmonic currents than those generated because of their own nonlinearity. Likewise, note that the load current, injected into the computer is most seriously misshaped with the highest THD of 145.36%.

THDs of PCC voltage and load currents are organized .the even column gives the all out harmonic distortion of voltage and current'

CALCULATION OF THE DPQINEW

It is presently prepared to calculate the according to the procedure in Fig. 2. Initially, the sixth-request (r=6) RMP model, which gives the best performance subsequent to testing a few RMP models with the other orders, is applied to discover the LCR. Then, its answer vector, L is gotten.

$$L=[k_1,k_2,k_3,k_4]^t=[LCR(i_f),LCR(i_r),LCR(i_c),LCR(i_m)]^t=[0.062,0.7961,0.0181,0.1237]^t$$

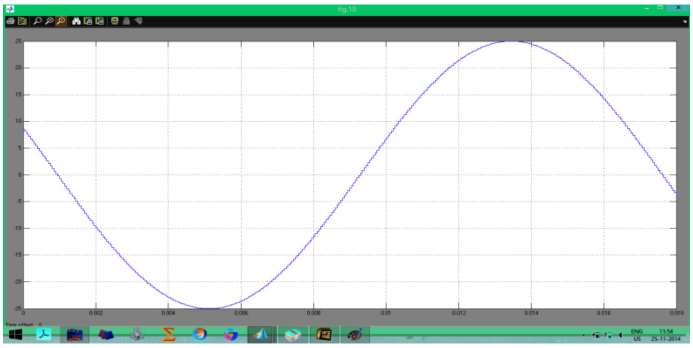

Fig. 7 Estimation of the total current i(t), by the RMP model.

With this LCR, the result of estimating the total load current i(t), is given in Fig.5.4.1 This shows very good estimation performance. Simulink model for finding total load current is as shown below.

SIMULINK model for finding total load current:

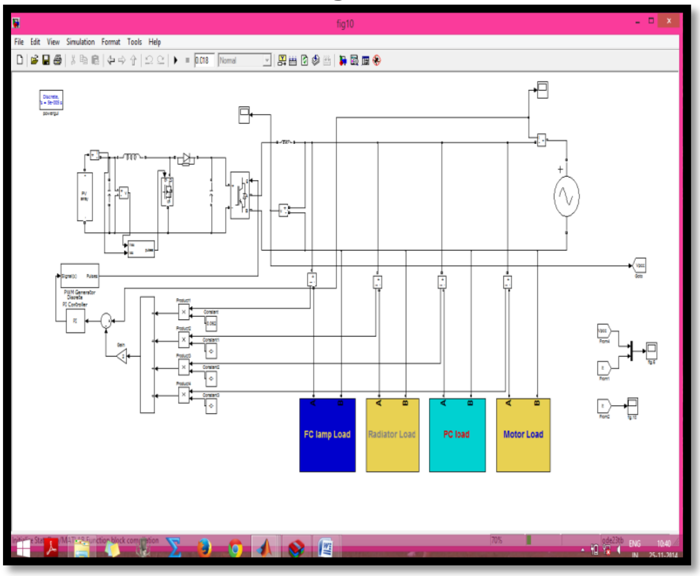

Fig 8 Simulink model for finding total load current

Also, when it is compared with the actual LCR of apparent powers, LCR (S_a), its performance is shown in Table 2.

Table 2 LCR of apparent powers and L

Load type	Fluorescent	Radiator	Computer	Motor
S_a[VA]	245	3134	126	487
LCR(S_a)	0.0614	0.7853	0.0315	0.122
L	0.0614	0.7853	0.0315	0.122

DETERMINATION OF THE HPR

By dividing the DPQI ^{NEW} by the sum of its each value, the normalized relative ratio of the index ($DPQI_R$ -^{NEW}) is obtained as [0.0854, 0.5122, 0.3079, 0.0945]. Then, the relative HPR is determined by the order of magnitude of the DPQI ^{NEW},and the result is given in Table 3.

Table 3 DPQI ^{NEW} and its corresponding HPR

Load type	Fluorescent	Radiator	Computer	Motor
$DPQI^{new}$	0.7312	4.385	2.636	0.809
$DPQI_R^{new}$	0.0854	0.5122	0.3079	0.0945
HPR	4	1	2	3
D[VA_d]	29.2	192.5	104.1	33.33
D_R	0.0813	0.5361	0.2899	0.0928
SMR	0.0013	0.0008	0.0014	0.001

Each factor of DPQIR ¬¬¬NEW indicates how much each load takes the piece of distortion power, D generated from each load with respect to the PCC in an overall system. It will in general be seen from Table III that the 'radiator' has the most exceedingly horrendous effect on the system by angering power quality issue with the highest HPR in spite of the fact that its current has minimal THD among the four load currents.

Then again, the distortion power D, for each load is computed by (3) as

D= [29.20, 192.54, 104.11, 33.33]

In like manner to the calculation of DPQIR ¬¬¬NEW, its standardized relative extent (DR) is gotten as [0.0813, 0.5361, 0.2899, 0.0928], and is shown in Table 5.3.

The solicitation in its size is exactly comparable to that of. This shows that the HPR tends to the exact situating of the distortion power produced from the nonlinear loads. Also, Table III shows that the upsides of SMR, which is characterized to endorse the proposed DPQI¬¬¬NEW for the distortion power, are minuscule as referenced previously.

These experimental results confirm that the DPQI ¬¬¬NEW can be effectively used as a decision-production list for power quality situating without requiring the direct assessment of distortion powers of each nonlinear load.

The proposed system is used to make a choice about the power quality rundown, which infers it gives the Harmonic Pollution Ranking to the loads which are contorted.

DRAWBACK OF THE DPQI ¬¬¬OLD

For a comparable assessment got in finished, the DPQI ¬¬¬OLD in (1) is currently calculated. The plan vector L, to measure the LCR is presently given as

L= [0.062, 0.7961, 0.0181, 0.1237] t

As referenced already, the THD (in) in (1) is calculated with the surveyed (not assessed) load currents with the supposition that an unadulterated sinusoidal voltage is supplied to the PCC. Therefore, another RMP model with the eighth-demand (r=8) is applied to survey the exact nonlinear load harmonics.

Except for the ir (t) injected into the radiator, which has the little phase difference with the VPCC (t) .The appraisal performances for the other currents are poor. Simulink model for discovering DPQI ¬¬¬OLD is as shown beneath

SIMULINK model for calculating DPQIold:

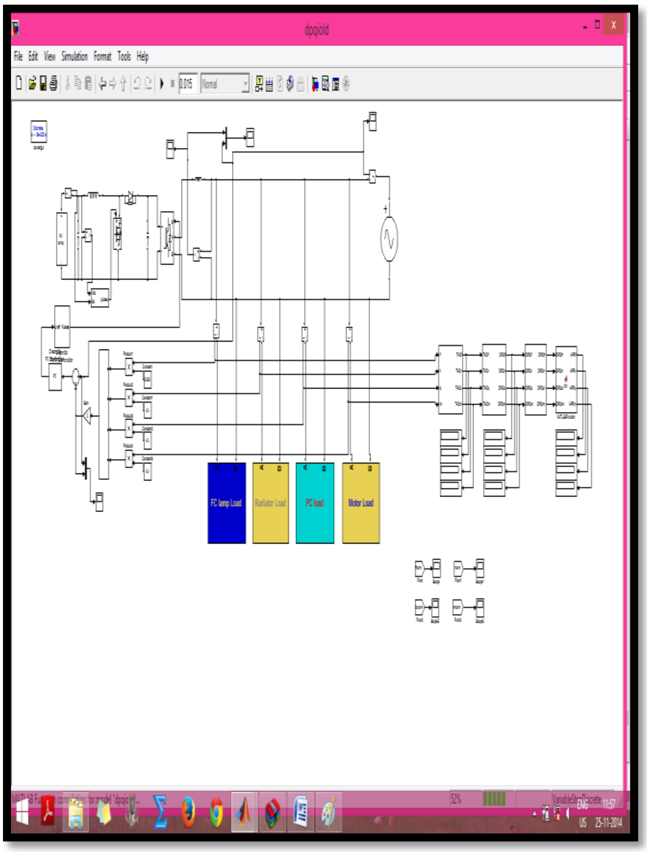

Fig 9 DPQI ^{OLD} model

The results of DPQI ^{OLD} and its corresponding HPR are given in Table 5.4.

Table 4 DPQI^{old} and its corresponding HPR

Load type	**Fluorescent**	**Radiator**	**Computer**	**Motor**
THD(i)[%]	**12.03**	**0.97**	**77.52**	**21.6**
DPQI$_R^{old}$	**0.7459**	**0.7716**	**1.403**	**2.671**
HPR	**4**	**3**	**2**	**1**

The above figure shows the fluorescent load current by RMP model. It is clearly show that with the incorrect HPR they give totally wrong answers. This proves that when the load current is severely distorted like the $i_c(t)$ the DPQI ^{OLD} has the serious drawback and/or with a low power factor it has a large phase difference with the $V_{PCC}(t)$.
The figure 11 shows the radiator current which is normalized. The graph gives the distorted power quality index information.

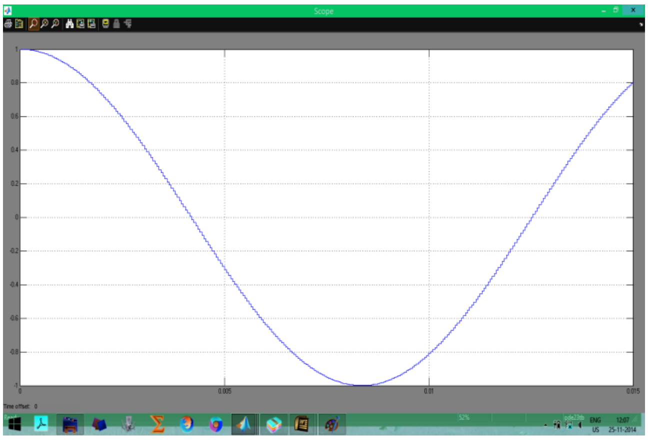

Fig 10 Estimation of load current i_f by the RMP model

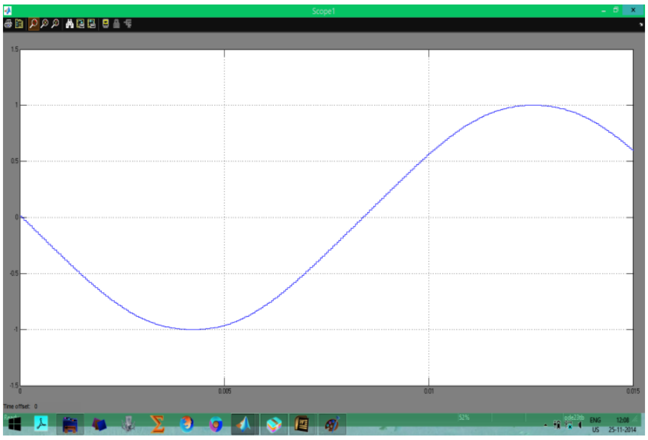

Fig 11 Estimation of load current i_r by the RMP model

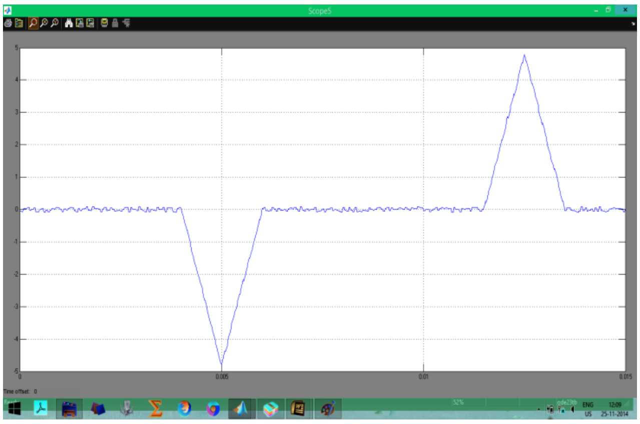

Fig.12 Estimation of load current i_c by the RMP model

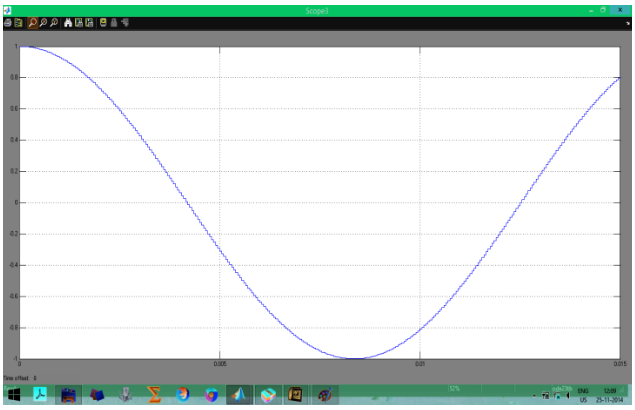

Fig 13 Estimation of load current i_m by the RMP model

The above figure is for load current that is computer standardized current by the RMP model. This figure is used for calculating HPR. This exhibits that when the load current is truly mangled like the ic(t) the DPQI ¬¬¬OLD has the real drawback .

The figure 13 tends to the motor load current which is calculated from RMP model.

TESTS IN THREE-PHASE BALANCED SYSTEM

The clear importance of distortion power is necessary to survey and verity the DPQInew. Although various theories have been produced for the single-phase case, their expansion to the three-phase system is similarly significant. Therefore, the proposed list is currently applied to a three-phase balanced system

It is minimal enough to exhibit the incredible appraisal performance of the proposed .Also, the performances of and to decide the HPR are compared in Table 4. It is clearly shown that the proposed has the superior performance to the. In Table 3, the relationship between and was not perfectly straight regardless of the fact that they are closely related.

HARMONIC CURRENT INJECTION MODEL

For the harmonic load modeling, a couple of methods such as a constant current source (CCS), crossed frequency admittance matrix (CFAM), Norton model, and harmonic current injection model have been commonly used. These can be selected by considering the compromise among simplicity and affectability. In this project, the harmonic current injection model is properly chosen on the justification re-enactment. In this method, any loads are tended to by totalling each effect of individual loads at a circulation level. Then, the absolute harmonic load is tended to by a harmonic current source in corresponding with some direct impedance.

The one-line chart of system used in the re-enactment is shown with the depiction of harmonic loads as referenced beforehand, the grid-connected inverter system accepts the part in mangling the PCC voltage with the low THD within 5%.

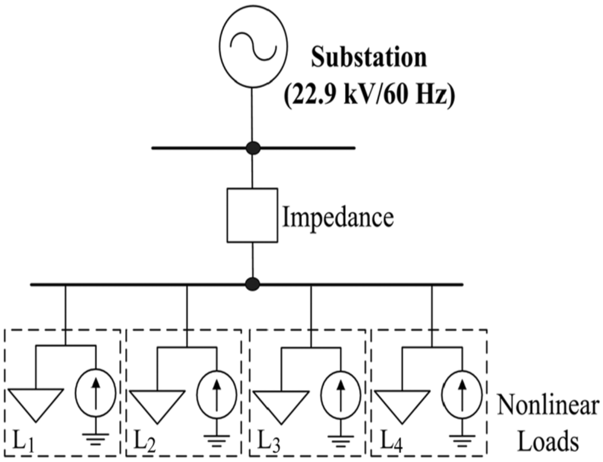

Fig 14 One-line diagram of system used in the simulation by the harmonic current injection model.

Then, the four nonlinear loads, which are selected by the load classification guide, are connected to the PCC. These are the fluorescent lighting, radiator, computer, and motor, which are implied by the subscripts f, r, c and m, respectively. For instance, as a little conveyance system reached out in power-scale with a 50 kW-scale PV based DG and typical loads such as, factories and commercial structures etc.

CONCLUSION

This papert proposed the new distortion power quality record to replace the recently proposed document. Its computation was carried out based on the load composition rate (LCR) and Euclidean standard of outright harmonic distortions (THDs) of the intentional voltage and current waveforms which are at the purpose for common coupling (PCC).The model that is reduced multivariate polynomial (RMP) with the a single shot getting ready property be successfully applied to survey the LCR. Additionally, the use of could do whatever it takes not to apply another RMP model, which is required in the execution of to evaluate the nonlinear load harmonics. This advantage thinks about more effective and optimal use in practice. In like manner, the experimental results showed that the can give the overall harmonic contamination situating (HPR) of a couple of nonlinear loads with incredible performance, which is directly related to their distortion powers without the necessity for direct assessments. In contrast, the results moreover checked that it has the certifiable drawback of acquiring incorrectly answers with an incorrect HPR. This was the case when the load current was truly wound with the high THD and/or when it had a huge phase difference with the PCC voltage with a low power factor.

The extraordinary evaluation performance of the proposed system and its applicability in practice was confirmed by the reproduction results based on the harmonic current injection model. It is expected to use the proposed as an effective instrument for noticing and dealing with the power quality in conveyance system similarly as in a residence.

FUTURE SCOPE

The proposed DPQI is expected to give the significant information to a supervisory control and data acquisition system or an advanced metering infrastructure for checking and directing the power quality in a more effective manner. The application of proposed DPQINEW to the domestic circulation power network selected as an exhibit complex for the execution of the micro grid is currently being investigated. Although various theories have been created for the single-phase case, their expansion to the three-phase system is also significant. Therefore, the proposed record is similarly applicable to a three-phase balanced system.

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