International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Development of Real Time Power Quality (RTPQ) Analyzer using Lab-VIEW

R. Bhavani, S. Ananthakumaran

Abstract*: Power Quality (PQ) issues and its alleviation techniques are becoming one of the vital research topics, soon after the integration of power electronic devices in power system. The non-linear nature of equipment's introduces PQ issues such as voltage sag, swell, harmonics, unbalance and transients etc. and cause damage of end user equipment's. Poor PQ has become a vital issue which affects production and profit of both utilities and consumers. Therefore continuous monitoring and assessment of PQ is essential for finding optimal solution to analyze and mitigate various PQ problems and also maintain quality of power within the prescribed limit. For PQ analysis, it is very difficult to generate power quality events in real life in order to observe the effects or to study their characteristics. Now days, various physical PQ analyzers are available in market to continuously monitor, analyze and record PQ problems. The major drawback of this analyzer is its hardware design, complexity and its cost which limits its usage to many places. Thus online PQ monitoring is a very big challenge for researches. This paper presents modeling and simulation of virtual PQ analyzer using Lab VIEW. Lab VIEW supports a lot of library functions for an acquisition, analysis of data and also the control of instruments. This software is mainly used to model standard real instruments used in laboratories by providing more flexibility. The proposed PQ analyzer is capable of generating, identifying various PQ problems and also measuring PQ parameters RMS Voltage (V_{rms}), RMS Current (I_{rms}), Total Harmonic Distortion (THD), Real, Reactive and Apparent Power from the test system. Using Lab VIEW software, a complete quality analysis of electric energy can be done online at the user's location. So that the selection of custom power devices and mitigation methods for PQ problems can be done in a perfect manner. This RTPQ analyzer is tested using real time data of hardware are acquired by the construction of test systems such as rectifier with various resistive and inductive loads. ALL PQ parameters measured using proposed PQ Analyzer are also compared with the parameters measured using fluke PQ Analyzer. The response attained has proven that the accuracy and precision of the proposed analyzer can also be used as a very good cost effective tool for online PQ study.

Keywords: Power Quality Analyzer, voltage sag, swells, harmonics, Total Harmonic Distortion, Power Quality Indices.

Manuscript published on 30 September 2019

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I. INTRODUCTION

PQ is a broad term used to describe the electrical power performance [1]. The widespread use of high-tech devices has complicated the quality of electrical power. This leads to poor PQ can result in less productivity, corruption of data, equipment damage, loss of reliability and huge economic loss. The frequently occurring PQ problems [2] are voltage sag, swell, interruption and harmonics. Voltage sags [3] are mostly caused by switching on heavy loads while the swells are mainly due to the sudden reduction of load and occurrence of single phase fault in a three-phase system. An interruption is the entire loss of supply voltage is mainly occurs due to the failure of grid equipment or the operation of the utility protective devices. Nonlinear loads are main cause for the origin of harmonics in the power system. Because of these continuous monitoring of PQ is essential for the successful operation of power sector and equipment's [4].

Over the years, conventional equipment's such as voltmeters, ammeters, power meters and also complicated power electronic devices are used for measuring circuit parameters, detection and investigation of harmonics present of frequencies. But, these meters are costly, occupies less space and also not providing the ability to store data, for future analysis and reference. Conventional PQ analyzer is an efficient tool to detect and analyze various PQ related problems[5] provides tremendous volume of raw data, about various phenomenon's with parameters values which can varying in wide ranges, difficult to analyze. Because of its complexity and high cost, it is not frequently preferred for many places and is infeasible for continuous measurement. For this reason automated analysis systems are preferred [6].

Lab VIEW [7] is a software tool provided by virtual instrumentation, mainly used for developing virtual meters without hardware components. Lab VIEW is a platform for visual programming language used for designing and developing systems in a user-friendly graphical programming environment. The Lab VIEW platform supports lot of tools and models for data acquisition, measurement and control applications. Lab VIEW having the ability of simulating a signal [8, 9], acquiring and displaying that signal using waveform charts is developed. Numeric controls are available on the front panel for feeding the required parameters. A virtual instrument characterizes a conventional hardware-centered system to software centered systems that shows the abilities of interconnection among workstations and desktop computers which are used for monitoring [10, 11] and also analysis of various PQ related events.

Now, researchers have used PQ monitoring using Lab VIEW [12-16] but those was not develop the entire PQ Analyzer and also were not tested for real signals.

This paper demonstrates the development of an accurate measurement tool Real Time PQ (RTPQ) analyzer to monitor and analyze various PQ problems and also used to measure different PQ Indices. This RTPQ analyzer takes input parameters as voltage and current signals that are taken from real time, identifies the magnitude and time of occurrence of various PQ problems Sag, Swell, Interruption, Over Voltage, and Under Voltage are also shown in graphical indicator. Various system parameters such as power (active, reactive, apparent), power factor, Frequency, Total Harmonic Distortion (THD) (%) were measured with different test conditions. Observations taken from the proposed analyzer is also compared with the physical PQ analyzer. The testing result obtained shows the feasibility of the proposed PQ analyzer which simply replaces the requirement of hardware and also a cost effective solution for PQ related problems.

II. Proposed RTPQ Analyzer

The schematic diagram of a proposed RTPQ analyzer is shown in Fig. 1.

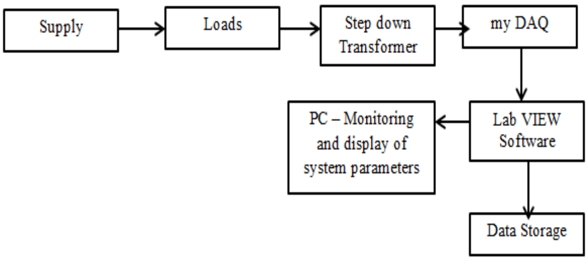


Fig. 1. Block Diagram for Virtual PQ Analyzer

It contains Personal Computer, Data Acquisition system (DAQ card from National Instruments) and a tradition made hardware unit. Various PQ events are generated at real time using custom made hardware module. DAQ card is used to acquire these signals inside Lab VIEW for measurement and analysis. It gets input from 8 analogue signals connected in differential mode, 8 digital input pins with a resolution of 24 bits and a sampling rate of 102.4 kilo samples per second, as well as 8 I/O digital lines. The software is developed using graphical programming language called Lab VIEW which is the trade mark of the National Instruments (NI), Austin, Texas, USA. Lab VIEW is a tool to provide graphical development programming atmosphere which can be used for developing virtual instruments that can be used in measurements and governor applications. It is also used to interface real-life signals and also analyses and store data as meaningful information. Lab VIEW has a features of built in functions called express VI's are used to create sinusoidal voltage waveforms in time domain by providing RMS voltage and response of frequency curves to continuously monitor the operating frequency. It supports DAQ card as an interfacing tool to interface the external hardware circuits with lab VIEW software using serial communication. Inside lab VIEW the obtained real world analogue signals (voltage or current) are converted into a form suitable for interfacing with other elements in the system hardware using signal conditioning. In this system, initially step down transformers are designed with output voltage of 12V to reduce the input voltage supplied from 230V.

This work especially addresses on the measurement of any real world signals to identify any disturbances of the voltage power line, and providing priority to the desires of consumers related with domestic and small scale industries.

III. Development of RTPQ Analyzer

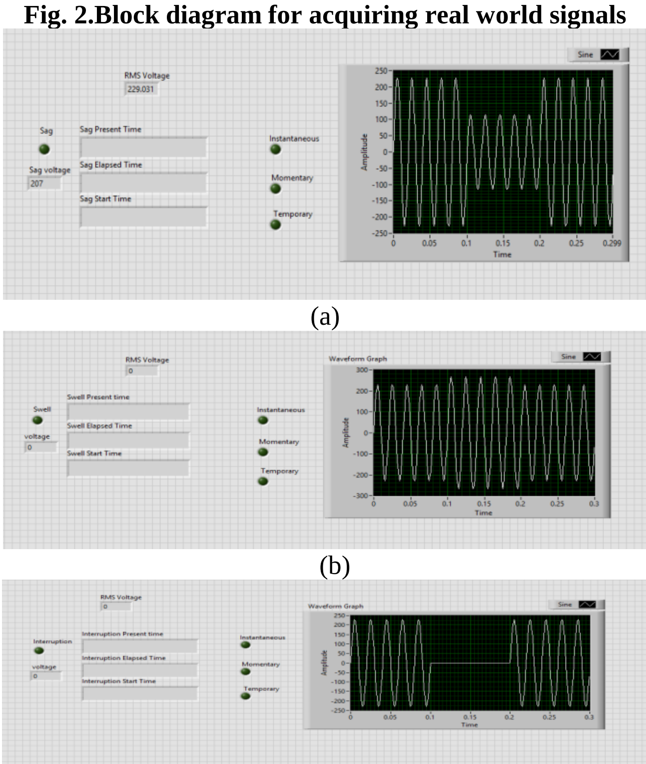
The proposed tool is established as a virtual instrument and the user interface is provided using lab VIEW software. This tool is used for the generation of various PQ problems for PQ study, identification and detection of PQ events with its start time, end time and its magnitude, captures PQ indices and also stores this data for post monitoring, analysis purpose.

A. Real Time Generation of PQ Problems

Various PQ related problems such as voltage sag, voltage swell, harmonics, and interruptions are generated in real-time using signal generator and are monitored using Personal Computer (PC) using NI-myDAQ device shown in Fig. 2.

Signal Generator NI-myDAQ Computer

Fig. 2.Block diagram for acquiring real world signals



(a) (b) (c)

Fig. 3. Front panel diagram for various PQ problems a) sag b) swell c) interruption

Retrieval Number C4192098319/19©BEIESP
DOI: 10.35940/ijrte.C4192.098319
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myDAQ is a device used to interface the hardware and the software (Lab VIEW). With the help of myDAQ, real time signals are acquired from the signal generator and give it to the Lab VIEW software through the computer. The highly powerful application is developed inside Lab VIEW software to detect and also identify different types of PQ problems and also its time duration, magnitude. Fig. 3(a-c) shows the developed front panel diagrams for the generation of various PQ problems.

B. Detection of PQ Events

The detection of various PQ the events (Sag, Swell, Interruption, Overvoltage and under voltage) are developed using front panel of Lab VIEW software is shown in Fig. 4. which also finds and display its starting time, present time , elapsed time of occurrence of PQ events. These data are stored in a file using Data Logging operation and also indicate all the events with the help of Booleans present in Lab VIEW.

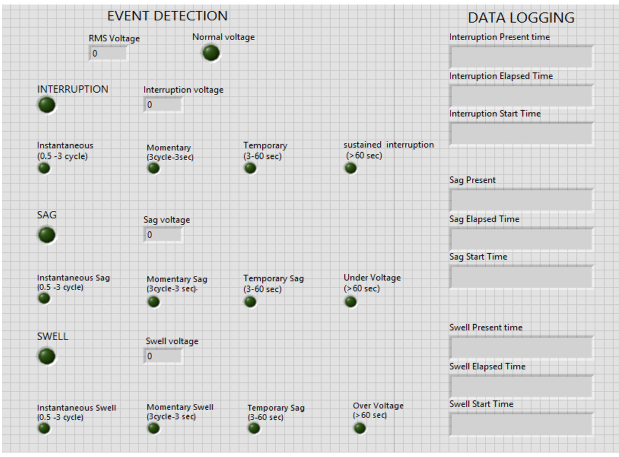

Fig. 4. Front panel results of PQ Event detection and Data logging.

Fig. 4 shows the developed front panel diagram for the PQ problems voltage sag and swell Event detection and Data logging. Here each and every event is indicated by the Boolean present in Lab VIEW. If the event is occurring then the corresponding Boolean will glow. Further each and every event is classified into Instantaneous, Momentary and Temporary according to the time duration. Then data logging is used to know the event start time, Elapsed time and Present time. Fig. 5 shows the block diagram of event detection for Voltage Sag and under voltage. From the input signal find out the RMS value then it is compared with the fixed range (23 to 207) with the help of Range Selector. If the voltage is between these ranges then automatically case structure will become true. So Elapsed time block will starts to run. If the RMS voltage is between 0.1 and 0.9pu and the duration are between 0.5 and 3 cycle means Instantaneous Boolean will glow. If the duration is between 3 cycle and 30 sec means Momentary Boolean will glow. If the duration is between 30 and 60sec means Temporary Boolean will glow. Once the duration is exceed beyond 60sec means under voltage Boolean will glow. Then all the information will be stored in Excel sheet with the help of Write to Measurement File present in Lab VIEW i.e. called Data Logging.

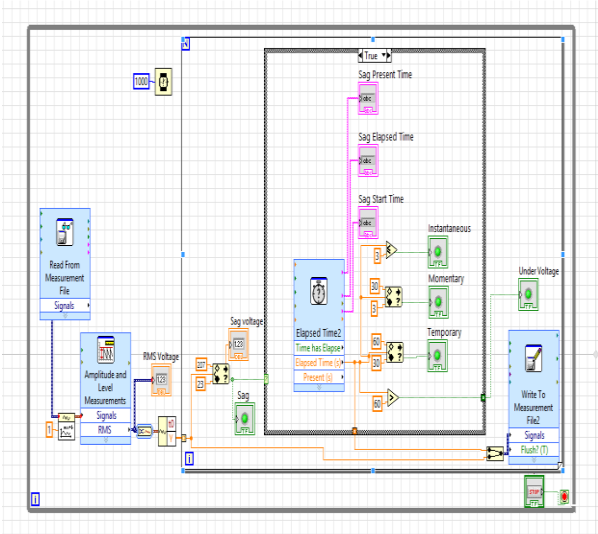

Fig. 5 Block diagram for the detection of Voltage Sag & Under voltage

C. Recording of data

Lab VIEW provides recording of data using Write to measurement file express file VI. Technical Data Management Streaming File Format is used for data logging. It consists of binary file for the data storage and the index file for the storage of associated information of all the attributes. It automatically generates MS-Excel file for PQ events when the program is executed. It consists of start time/date, duration of the occurrence of event and also its magnitude. Fig. 6 shows the Data logging part of sag. It shows the event Start time, Elapsed time and the respective voltage levels.

SAG ELAPSED TIME(sec)	TIME	VOLTAGE(V)						
0	15-03-2018 09:06:11.115	227.96559	8.00021	15-03-2018 09:06:35.079	114.2467	32.00171	15-03-2018 09:06:59.081	114.9125
0	15-03-2018 09:06:12.079	227.974488	9.000236	15-03-2018 09:06:36.079	114.3093	33.00371	15-03-2018 09:07:00.083	114.8551
0	15-03-2018 09:06:13.080	228.001219	10.00011	15-03-2018 09:06:37.079	114.3756	34.00271	15-03-2018 09:07:01.082	114.7928
0	15-03-2018 09:06:14.079	228.045356	11.0016	15-03-2018 09:06:38.081	114.4446	35.00371	15-03-2018 09:07:02.083	114.7267
0	15-03-2018 09:06:15.079	228.106192	12.00135	15-03-2018 09:06:39.081	114.5153	36.00273	15-03-2018 09:07:03.082	114.6579
0	15-03-2018 09:06:16.080	228.182756	13.0017	15-03-2018 09:06:40.081	114.5865	37.0028	15-03-2018 09:07:04.082	114.5873
0	15-03-2018 09:06:17.079	228.273824	14.00171	15-03-2018 09:06:41.000	114.6572	38.00326	15-03-2018 09:07:05.082	114.516
0	15-03-2018 09:06:18.079	228.377945	15.00171	15-03-2018 09:06:42.081	114.7261	39.00327	15-03-2018 09:07:06.000	114.4453
0	15-03-2018 09:06:19.079	228.493458	16.00084	15-03-2018 09:06:43.080	114.7922	40.00327	15-03-2018 09:07:07.082	114.3763
0	15-03-2018 09:06:20.079	228.618528	17.0017	15-03-2018 09:06:44.081	114.8545	41.00326	15-03-2018 09:07:08.082	114.3099
0	15-03-2018 09:06:21.000	228.751167	18.00171	15-03-2018 09:06:45.081	114.9119	42.00289	15-03-2018 09:07:09.082	114.2473
0	15-03-2018 09:06:22.080	228.889273	19.00171	15-03-2018 09:06:46.081	114.9637	43.00315	15-03-2018 09:07:10.082	114.1895
0	15-03-2018 09:06:23.079	229.030658	20.00171	15-03-2018 09:06:47.081	115.009	0	15-03-2018 09:07:11.082	227.9656
0	15-03-2018 09:06:24.080	229.173091	21.0017	15-03-2018 09:06:48.081	115.047	0	15-03-2018 09:07:12.082	227.9745
0	15-03-2018 09:06:25.080	229.314325	22.0017	15-03-2018 09:06:49.081	115.0772	0	15-03-2018 09:07:13.082	228.0012
0	15-03-2018 09:06:26.080	229.452135	23.00171	15-03-2018 09:06:50.081	115.0992	0	15-03-2018 09:07:14.082	228.0454
0	15-03-2018 09:06:27.079	113.982795	24.00171	15-03-2018 09:06:51.081	115.1125	0	15-03-2018 09:07:15.082	228.1062
1.000021	15-03-2018 09:06:28.079	113.987244	25.00171	15-03-2018 09:06:52.081	115.117	0	15-03-2018 09:07:16.082	228.1828
2.000069	15-03-2018 09:06:29.079	114.00061	26.00171	15-03-2018 09:06:53.081	115.1126	0	15-03-2018 09:07:17.082	228.2738
3.000096	15-03-2018 09:06:30.079	114.022678	27.0027	15-03-2018 09:06:54.082	115.0994	0	15-03-2018 09:07:18.082	228.3779
4.000121	15-03-2018 09:06:31.079	114.053096	28.00164	15-03-2018 09:06:55.081	115.0775	0	15-03-2018 09:07:19.082	228.4935
5.000144	15-03-2018 09:06:32.079	114.091378	29.00162	15-03-2018 09:06:56.081	115.0473	0	15-03-2018 09:07:20.082	228.6185
6.000164	15-03-2018 09:06:33.079	114.136912	30.00171	15-03-2018 09:06:57.081	115.0094	0	15-03-2018 09:07:21.082	228.7512
7.000188	15-03-2018 09:06:34.079	114.188972	31.00271	15-03-2018 09:06:58.082	114.9642	0	15-03-2018 09:07:22.082	228.8893

Fig. 6 Data logging for voltage Sag

From the table up to 15-03-2018 09:06:27 shows the normal voltage level (229.452135). After that the voltage is reduced to 113.982795 it indicates the Sag event. So Sag Elapsed time start to count the total duration of the event occurred. From the observation table calculated the total duration of the sag event (43 sec). Then again comes to normal voltage. Similarly the lab view software for the detection and identification of the time of occurrence and the magnitude of various events swell, overvoltage, interruption are developed using NI block diagram.

Retrieval Number C4192098319/19©BEIESP
DOI: 10.35940/ijrte.C4192.098319
Journal Website: www.ijrte.org

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Thus the proposed RTPQ analyzer provides a very interactive graphical user interface for the detection, identification of various types of PQ problems with its magnitude and also provides an accurate time at which that particular event was initiated and also ended. The obtained results are verified for the waveform shown in Fig. 7.

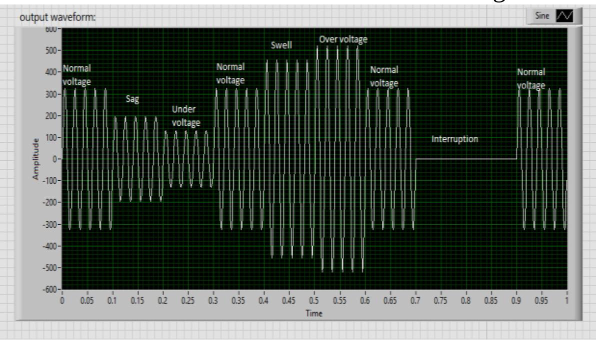

Fig. 7 Overall waveforms of PQ problems

D. Measurement of PQ Indices

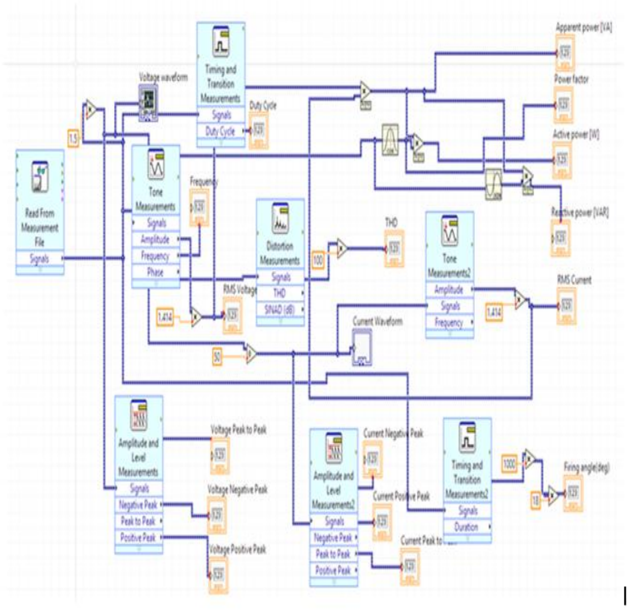

Fig. 8.Block diagram for the measurement of PQ Indices

Power quality (PQ) indices are used to compute the quality of the power supply, compensation capabilities and also dynamic responses of PQ mitigation equipment. The PQ indices are RMS voltage, RMS current, real power, reactive power, apparent power, power factor, frequency and Total Harmonic Distortion (THD) used to define the specific types of power disturbances and these indices are based on measurements taken for offline for a particular time therefore, and they are not able to expose the time varying characteristic of a specific type of power disturbance. The proposed is a real time PQ analyzer used to provide online computation of PQ indices for the existing PQ problem. Fig. 8 illustrations the schematic diagram of the RTPQ analyzer for online measurement of various PQ indices.

IV. TESTING OF RTPQ ANALYZER

The proposed RTPQ analyzer is tested using three different types of loads rectifier load, bulb and choke load by measuring all the PQ indices.

A. Rectifier Load

This system consists of single phase, 230 V; 50 Hz sinusoidal source voltage connected with bridge rectifier with resistive load is shown in the Fig .9. Rectifier output is given to the myDAQ. My DAQ is a device used to interface the hardware and the software (Lab VIEW). With the help of analog pin of my DAQ acquire the signal from the rectifier and give it to the Lab VIEW software through the computer. The proposed RTPQ Analyzer measures all the factors like Active power, apparent power, Reactive power, THD and Frequency are obtained.

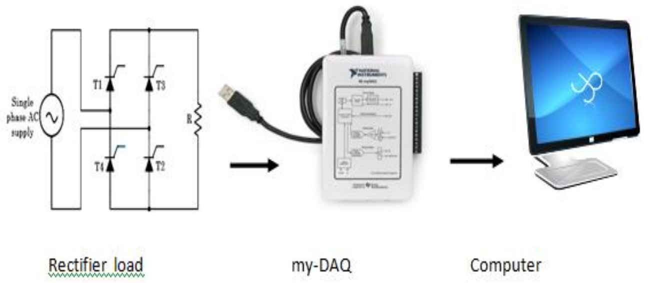

Fig. 9.Block diagram of test system

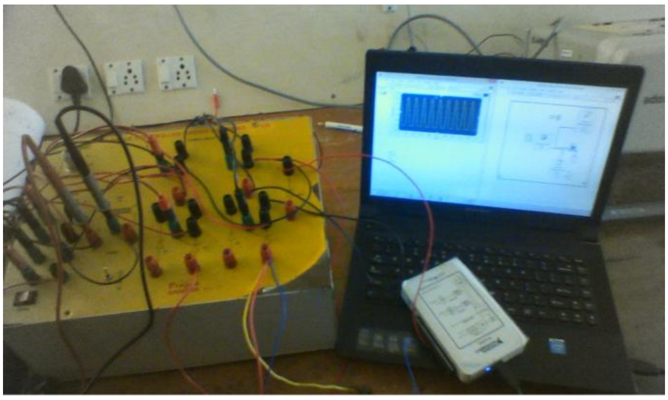

Fig. 10 Hardware setup of Rectifier Load

The results obtained for this test system are displayed in a front panel of Lab VIEW shown in Fig. 11. This shows the output voltage waveform of rectifier and the measured parameters power, reactive power, apparent power, PF, frequency, RMS voltage etc.

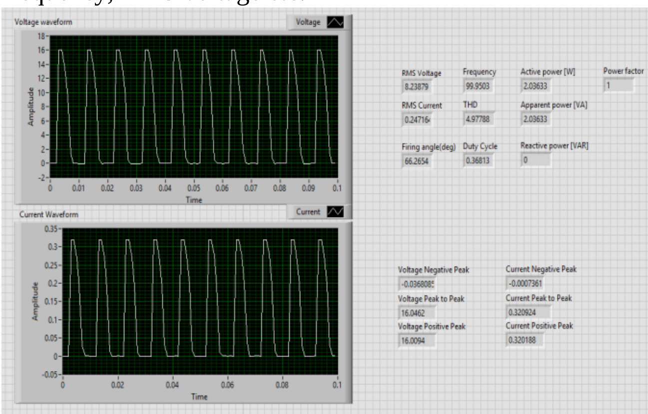

Fig. 11. Front panel and waveforms for rectifier load

B. Bulb Load

Two incandescent bulbs each rated at 40 W to single phase 50 Hz AC supply. Bulb output is given to my DAQ through the step down transformer. The hardware setup of bulb load is shown in Fig. 12. PQ indices are measured using proposed PQ analyzer shown in Fig. 13. An incandescent lamp is a linear load so that the power factor measured is unity.

Fig. 12. Hardware setup for the testing of bulb load

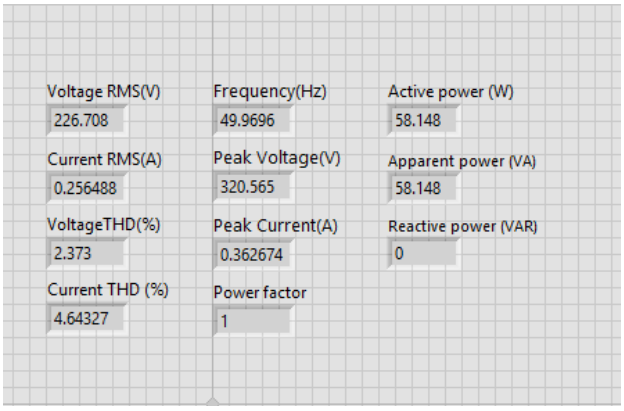

Fig. 13.PQ indices measured using RTPQ Analyzer for bulb load.

C. Choke Load

Fig. 14 shows the Hardware setup of choke load. Choke load output is given to the myDAQ through the step down transformer. myDAQ is a device used to interface the hardware and the software(Lab VIEW). With the help of analog pin of my DAQ acquire the signal from the rectifier and give it to the Lab VIEW software through the computer. With the help of output signal from my DAQ, calculated all the parameters such as THD, Active power, apparent power, Reactive power, and Frequency etc.

Fig. 14. Hardware setup for the testing of bulb load

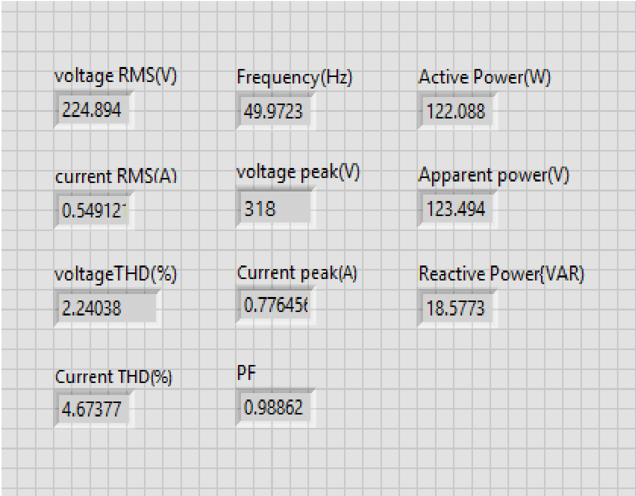

Fig. 13.PQ indices measured using RTPQ Analyzer for bulb load

The simulation results obtained for the test system with choke load (40W) using Lab VIEW is shown in Fig. 15. Here 40W Choke is used and then calculated all parameters such as Real Power, Reactive Power, Apparent Power, PF, Frequency, RMS Voltage and Current etc.

V. PERFORMANCE ANALYSIS

The proposed PQ analyzer is tested for the three different loads and the PQ indices for these loads are also observed. The results are verified with the measurements taken from conventional fluke PQ Analyzer is shown in Table.1. From the results, it is concluded that the proposed virtual RTPA analyzer exactly replaces conventional PQ Analyzer .Thus eliminated the requirement of hardware, space and cost of fluke PQ Analyzer also provides real time monitoring and measurement of signals.

Table 1.Performance measurement of RTPQ PQ Analyzer

Types of Load	PQ Indices	Measured Values	
		Using RTPQ in Labview	Using Fluke PQ Analyser
Rectifier Load	RMS Voltage(V)	8.23879	8.4862
	RMS Current(A)	0.24716	0.1697
	Frequency(Hz)	99.9503	100
	Active Power(W)	2.03633	1.4399
	Reactive Power(Var)	0	0

	Apparent Power(VA)	2.03633	1.4399
	Power Factor	1	1
	THD (%)	4.97788	5.1
	Duty Cycle	0.36813	0.448
Bulb Load	RMS Voltage(V)	226.708	227.6
	RMS Current(A)	0.25648	0.28
	Frequency(Hz)	49.9696	50
	Active Power(W)	58.1480	63.728
	Reactive Power(Var)	0	0
	Apparent Power(VA)	58.1480	63.728
	Power Factor	1	1
	THD (%)	2.3730	3.1
Choke Load	RMS Voltage(V)	224.894	228.9
	RMS Current(A)	0.54912	**0.56**
	Frequency(Hz)	49.973	50
	Active Power(W)	122.088	126.902
	Reactive Power(Var)	18.5773	18.0825
	Apparent Power(VA)	123.494	128.184
	Power Factor	0.9886	0.99
	THD (%)	4.67377	5.9

VI. CONCLUSION

In this project, a virtual PQ analyzer for isolated monitoring of PQ disturbances has been effectively developed using Lab VIEW and also tested with laboratory experimental setup. The developed RTPQ analyzer generates simulated signal, identifies and displays various PQ disturbances waveforms, analyses the harmonics content and also generates a report. DAQ card is to be used for real time monitoring. The results have been shown on the front panel VI of the computer screen called Virtual Instruments same as displayed in on instrument. The established event logger had shown precise and detailed logging of PQ events such as Voltage Sag, Voltage Swell and Interruption. The procedures for computing and recording of real world data have been developed inside Lab VIEW software as per the guidelines of the standards given by IEEE. Harmonics are introduced by non-linear loads that produce numerous unwanted effects such as increase in losses, thermal stress and reduced equipment life time. It also provides one more feature trigger. This triggering mechanism provides RTPQ analyzer for continuously monitoring real world signals, if the signal recognizes any PQ related events, it triggers and also save the data based on its ability. The performance of Lab VIEW on PQ analysis is verified using various experimental set up such as full bridge rectifier circuit using R load, Bulb and Choke loads and the various PQ indices are continuously measured and monitored. It is very cost effective than the Physical instrument and Portable system with greater storage capacity. Also it is suitable for remote monitoring application. The results from the Lab VIEW have been tested against existing PQ analyzer and are proven that the proposed RTPQ analyzer is more accurate than physical PQ analyzer. So this Virtual PQ analyzer is an exact replacement of physical PQ analyzer completely eliminates hardware requirement, space and cost.

REFERENCES

1. Bollen, M.H.J., "Understanding Power Quality Problems", IEEE, Piscataway, 2010.
2. Edomah, N., "Effects of Voltage Sags, Swell and Other Disturbances on Electrical Equipment and Their Economic Implications", the 20th International Conference on Electricity Distribution, Prague, vol. 8(11), pp.1-4,2009.
3. Martinez,J.A, Arnedo,J.M., "Voltage Sag Studies in Distribution Networks-partI: System modeling", IEEE Transactions on Power Delivery, vol.21(3), pp.338–345,2006.
4. L. F. Auler, Roberto d'Amore, "Power Quality Monitoring and Control using Ethernet Networks", IEEE Transactions on Power Delivery, pp, 208-213, 2002.
5. Mr.Vinit Kumar, Mr.Manbir, Mr.Kaur, "Power Quality Event generation in MATLAB for Simulink Environment", International Journal of Advance Research in Electrical, Electronic Instrumentation Engineering, vol. 4(7), 2015.
6. De Yong, D, "Educational software for power quality analysis", Latin America Transactions, IEEE (Revista IEEE America Latina), vol.11 (1), pp.479-485, 2013.
7. Gupta Sanjay and John Joseph, "Virtual Instrumentation using Lab VIEW", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
8. Bath, S. K., Kumra, S., "Simulation and Measurement of Power Waveform Distortions using Lab VIEW", IEEE International Power Modulators and High Voltage Conference, Proceedings of the 2008, vol. 4, pp.427-434, 2008.
9. Ms.Swarupa, Ms.Vishnuvardhini, Ms.Poongkuzhali, Ms.Sindhu, "Power Quality Analysis using Lab VIEW", International Journal of Engineering Research and Applications, vol. 3(3), pp. 322-331, 2014.
10. Dr.Puneetpahuja, Mr.Ravi, Mr.Prateek Chandra, Mr.Savita, "Power Quality Monitoring using LabVIEW", International Journal of Electrical, Electronics and Computer Engineering, vol.4(2),pp.59-65,2015.
11. Laskar, Shahedul Haque; Muhammad, Mohibullah, "Power Quality Monitoring by Virtual Instrumentation using LabVIEW", Universities' Power Engineering Conference (UPEC), Proceedings of 2011 46th International, vol.1 (6), pp. 5-8 ,2011.
12. Alves, R.; Goncalves, D.; Pinto, J.G.; Batista, J.; Afonso, J.L., "Development of an Electrical Power Quality Monitor based on a PC", Industrial Electronics, 2009, IECON '09, 35th Annual Conference of IEEE , vol.3(5), pp.3649-3653, 2009.

13. Jing Chen, Tianhao Tang, "Power quality analysis based on LABVIEW for current power generation system", Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), 2012 International Symposium on , vol.20(22), pp.865-870,2012
14. Qiu Tang, Zhaosheng Teng, Siyu Guo, Yaonan Wang, "Design of Power Quality Monitoring System Based on LabVIEW," Measuring Technology and Mechatronics Automation, 2009, ICMTMA '09, International Conference on vol.11 (12), pp.292-295, 2009.
15. H E Wenhai, "Design of the Noise Testing System Based on LabVIEW", Computer Sciences and Convergence Information Technology, 2009, ICCIT '09, Fourth International Conference, vol.24(26),pp.95- 98, 2009.
16. Jinfeng Ren, Stefan Giurgea, “A hybrid method for power system frequency estimation”, IEEE Transactions on power delivery, vol. 27(3), pp: 1252 - 1259, 2012.
17. Dr. Puneet Pahuja, Ravi, Prateek Chandra and Savita, “Power Quality monitoring using Lab VIEW”, International Journal of Electrical, Electronics and Computer Engineering, vol.4(2), pp.59-65,2015.

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