

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 9, September 2018

Artificial Intelligence Based Power Quality Monitoring and Improvement System Using NI LabView

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ABSTRACT: This paper presents a design of a virtual instrument which will not only monitor the power quality continuously but also improves the quality by using different filters in LabVIEW and other toolkits. The power quality depends on lot of parameters like harmonics, noise, voltage and current fluctuations, phase, fundamental frequency etc. The NI LabVIEW Electrical Power Suite helps to develop a custom single- or three-phase power monitoring, metering, or quality analysis application. With the LabVIEW Electrical Power Suite, one can combine the fixed standardized algorithms from the power industry with the custom capability of a full programming language and modular hardware.

KEYWORDS: Power Quality, NI LabView, Filters, Fuzzy Controller, THD.

I. INTRODUCTION

Monitoring and improvement of power quality is required in power system for better execution, supervision and control over the power system and related equipment. Power quality is defined as to get perfectly sinusoidal voltage having 50 Hz. and 220V (or standard voltage as per requirement) uninterrupted power supply to the customers. The power quality depends on lot of parameters like harmonics, noise, voltage and current fluctuations, phase, fundamental frequency etc. Power quality monitoring devices are very costly and power quality improvement is also very cumbersome job. Hence the investigator wants to design a virtual instrument which will not only monitor the power quality continuously but also improves the quality by using different filters in LabVIEW and other toolkits.

II. RELATED WORK

[1] Leonaş Ciulinaru has described that electric power quality checking, intending to act continuously and to record every ordinary variety forced by IEC norms 61004-30 and CEI EN 50610. The displayed system is adaptable and opened to changes, by methods for minimal effort computerized system advancement, turned out to be a valuable device for control quality checking and power management. Voltage and current estimations are made through Hall-impact sensors associated with a standard information securing board, and the virtual instrument is worked in LabVIEW™, running on Windows in a normal PC. The system obtains information constantly, and stores in documents the occasions that outcome from inconsistencies identified in the power system that is being observed.

[2] Juan José González de la Rosa1, J. M. Sierra Fernández has described a virtual instrument for PQ appraisal. Considered to identify drifters, lists and swells, the computational core is situated in higher-arrange insights, which upgrade the factual portrayal of the crude information, with the subsequent change of the instrument's execution. This estimation application is believed to be utilized by the plant administrator beforehand prepared in PQ investigation. The typical activity restrain is already settled on exact master information. The instrument additionally permits online

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perception of the measurable parameters (change, skewness and kurtosis). The repeatability is 85% generally. Results pass on the possibility of a simple transferable innovation, because of its minimal effort and enhanced computational core.

III. POWER QUALITY MEASUREMENT AND IMPROVEMENT

The requirement for follow up and checking of power quality is increasing and a number of different national norms and regulations have been introduced to give guidance for what is to be considered good power quality.

- Voltage fluctuation
- Transients in power line
- Power factor of the power supplied
- Different Harmonics content present in power system
- Fundamental Frequency

The good power quality must be maintained for proper functioning of electrical equipment. There are many methods used for power quality improvement. However the investigator will use filters to improve the power quality.

IV. TOOLS AND SOFTWARES USED

The main programming software which will be used in developing the virtual instrument is LabVIEW . In accumulation to that, other toolkits of LabVIEW and graphics softwares will also be used to augment the functionality of the project.

V. METHODOLOGY

The work will be executed by following the steps mentioned below sequentially:

1. Identification of input/output parameters of Power quality
2. Identification of Noises, harmonics etc.
3. Designing of Front panel.
4. Designing of block diagram (Coding) according to the output required
5. Tested for accuracy
6. Validation

VI. BLOCK DIAGRAM

Block diagram of proposed system shown below in Fig.1, which describes that fuzzy systems have been broadly used for a wide engineering applications. Especially, it has been successfully applied in control systems and decision-making systems.

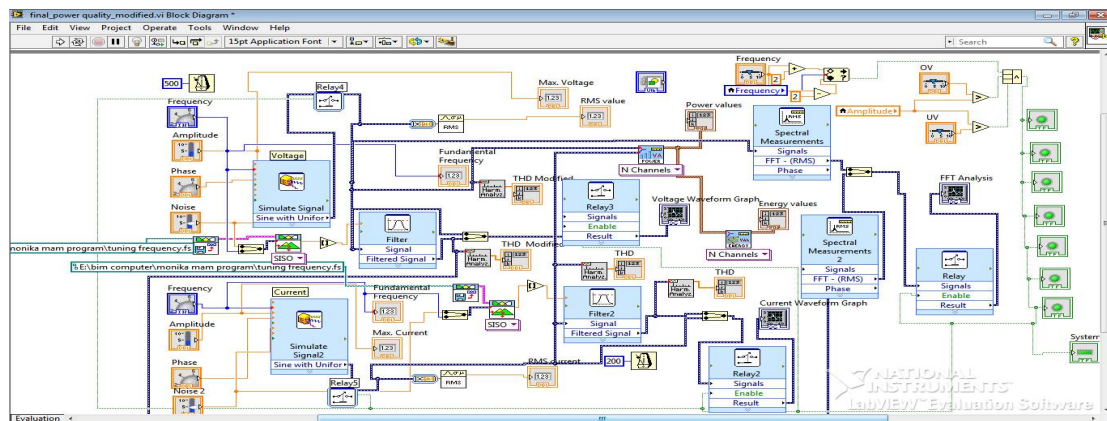


Fig.1 Block Diagram

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VI. SECTIONS OF THE WORKING MODEL

The various sections are:

Voltage section, Current section, Current wave form graph, Voltage wave form graph, Power values Energy value, Voltage parameter and Current parameter.

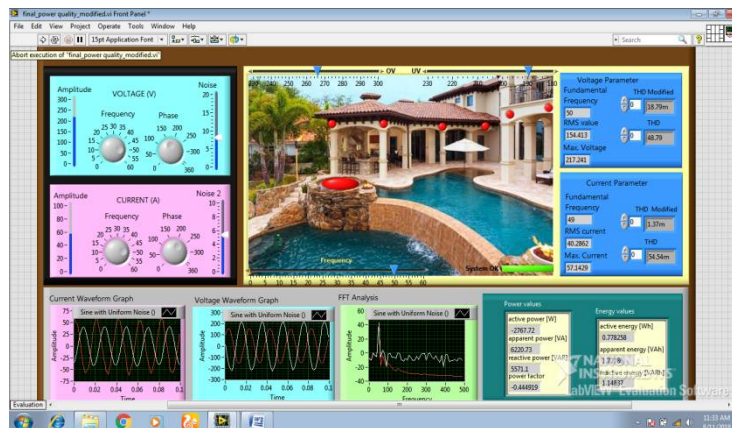


Fig.2 shows different sections of power quality

1. Voltage section:

Diagram of proposed system shown below in fig.3 describes that it consists of four parts i.e. amplitude, frequency, phase, and noise.

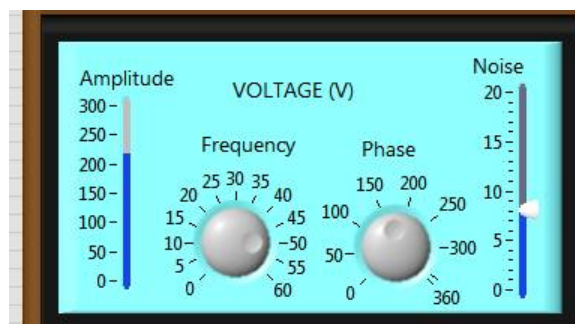


Fig.3 Voltage section

- (a) **Amplitude:** From amplitude, we can set the testing or generating voltage. Amplitude is connected with the amplitude section of simulate signal graphical code/control.
- (b) **Frequency:** From frequency section, we can set the testing or generating power frequency. frequency is connected with the frequency section of simulate signal graphical code/control.
- (c) **Phase:** From phase section, we can set the testing or generating phase. Phase is connected with the phase section of simulate signal graphical code/control. Its value lies between 0-360 degrees.
- (d) **Noise:** Different types of noise may be added to create the signal noisy and with low power quality signal. The final signal we may see from simulate signal as shown below in fig. 4

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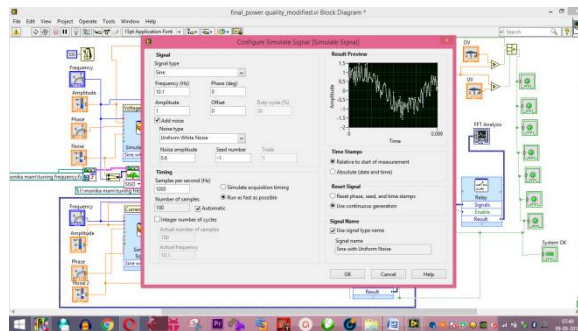


Fig.4 Final signal

- CURRENT SECTION:** Diagram of proposed system shown below in fig.5 describes that it consists of four parts i.e. amplitude, frequency, phase, and noise.

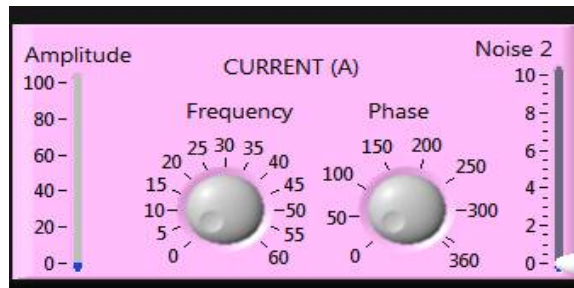


Fig.5 Current section

- (a)**Amplitude:** From amplitude, we can set the testing or generating voltage. Amplitude is connected with the amplitude section of simulate signal graphical code/control.
- (b)**Frequency:** From frequency section, we can set the testing or generating frequency. frequency is connected with the frequency section of simulate signal graphical code/control.
- (c)**Phase:** From phase section, we can set the testing or generating phase. Phase is connected with the phase section of simulate signal graphical code/control. Its value lies between 0-360 degrees.
- (d)**Noise 2:** Different types of noise may be added to create the signal noisy and with low power quality signal. The final signal we may see from simulate signal as shown below in fig. 6

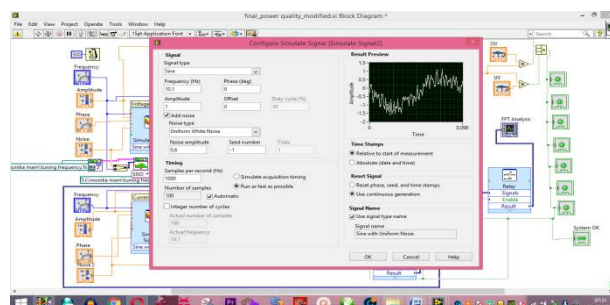


Fig.6 Final Signal

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3. CURRENT WAVEFORM GRAPH

Current waveform graph shows the graph of current before filter and after filter. It is shown in fig.7

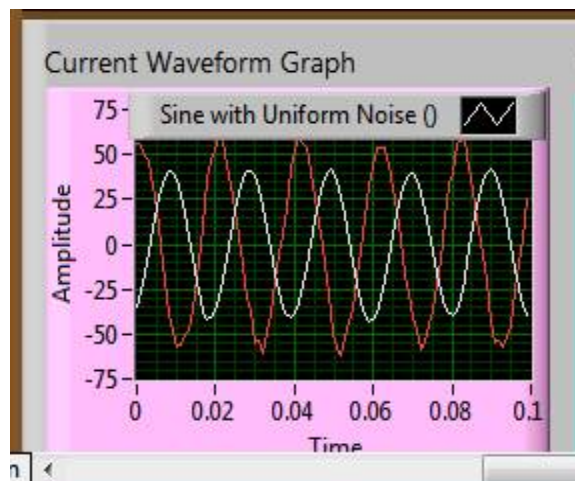


Fig.7 Current Waveform Graph

The filter used in current filtration is shown in fig. 8

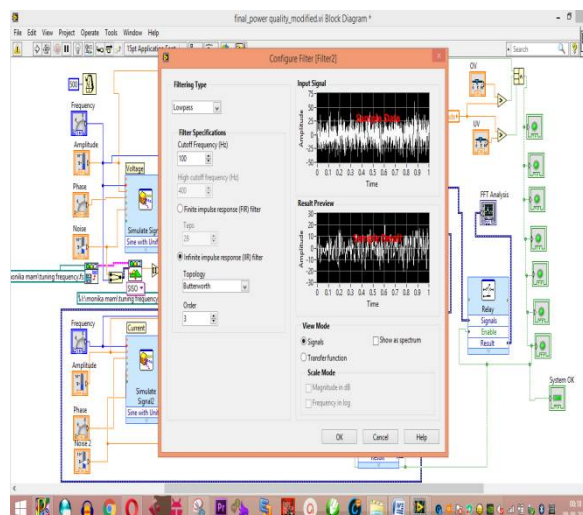


Fig.8 Current filtration

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4. VOLTAGE WAVEFORM GRAPH

The filter used in voltage filtration is shown in fig. 9

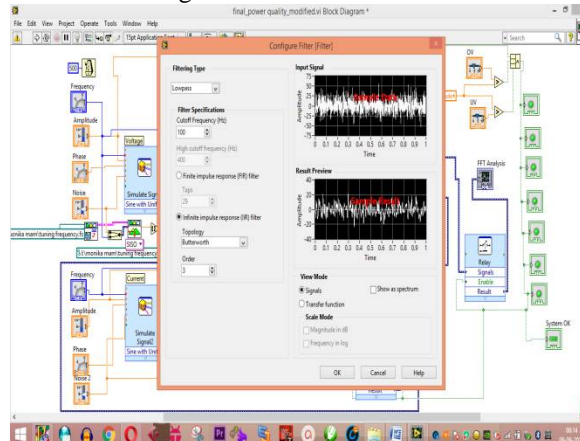


Fig.9 Voltage filtration

5. POWER VALUES

Power values shows following powers in the project:

1. Active power
2. Apparent Power
3. Reactive power
4. Power Factor

6. ENERGY VALUES

Following energy values has been simulated in the project:

1. Active Energy
2. Apparent Energy
3. Reactive Energy

7. VOLTAGE PARAMETER

In fig.10, voltage parameters simulated is shown. Different parameters simulated are as follows:

1. Frequency: It is the frequency of the signal.
2. RMS Value: It shows the RMS value of the signal
3. Maximum Voltage: It shows the max. value of the signal
4. THD: This is the total harmonic distortion before filter
5. THD modified: This is the total harmonic distortion after filter

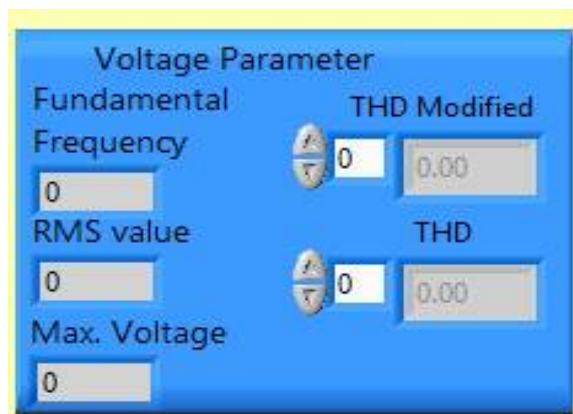


Fig.10 Voltage Parameter

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8. CURRENT PARAMETER

In fig.11, current parameters simulated are shown. Different parameters simulated are as follows:

1. Frequency: It is the frequency of the signal.
2. RMS Value: It shows the RMS value of the signal
3. Maximum Voltage: It shows the max. Value of the signal
4. THD: This is the total harmonic distortion before filter
5. THD modified: This is the total harmonic distortion after filter.

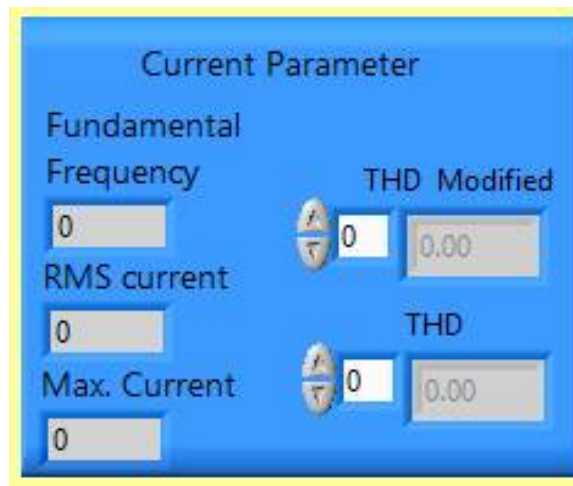


Fig.11 Current Parameter

FILTER USED

The filter used is shown below in fig. 12

Low pass filter with 100Hz cut-off frequency if used. Butterworth topology is used to filter the signal.

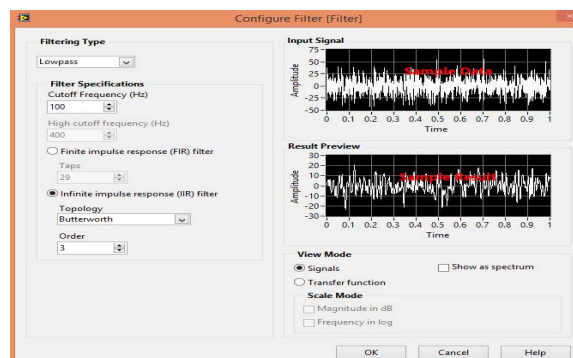


Fig.12 Filter Reading

VII.CONCLUSION

The project is highly beneficial for power quality engineers, engineering institutes, industries etc.

How the project is different from others:

1. Compact one standalone fuzzy controller for power quality control

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2. Over voltage & Under voltage protection implemented
3. Change of device parameter as per requirement
4. Whole project is flexible and may be easily modified as per nature and choice industry
5. 24/7 power quality monitoring and control

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