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EXTENSIVE LABVIEW BASED POWER QUALITY MONITORING AND PROTECTION SYSTEM

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ABSTRACT

Power quality issues and mitigation techniques became hot research topics soon after the introduction of solid state devices in power system. The equipments of non-linear nature introduce power quality issues such as harmonics, reduction in power factor, voltage unbalance, transients etc. and cause malfunction or damage of power system equipments. In this paper, harmonics, noises, reactive power etc. are considered as major issues. There is an ever increasing need for power quality monitoring systems due to the growing number of sources of disturbances in AC power systems. Monitoring of power quality is essential to maintain proper functioning of utilities, customer services and equipments. The authors surveyed different existing methods of power quality monitoring already in use and available in literature and arrived at the conclusion that an improved and affordable power quality monitoring system is the need of the hour. This paper presents the development of a simple power quality system for the purpose of measurement by designing virtual instruments using LabVIEW software. The real time data of hardware are acquired and fed to the software using Arduino for interfacing with LabVIEW. All power quality parameters are also measured by fluke power analyzer for validation. Observations taken from the hardware under test depict the importance of power quality monitoring, and also the accuracy and the precision of the developed system. The testing results and analysis indicate that the proposed method is feasible and practical for analyzing power quality disturbances.

Keywords: Power quality monitoring, power quality software, power quality parameters.

I- INTRODUCTION

Power quality decides the wellness of electrical energy to customer gadgets. Synchronization of the voltage recurrence and stage permits electrical frameworks to work in their expected way without critical loss of execution or life. The term is utilized to portray electric power that drives an electrical burden and the heap's capacity to work appropriately. Without the best possible power, an electrical gadget (or burden) may glitch, come up short rashly or not work by any means. There are numerous routes in which electric power can be of low quality and numerous more reasons for such low quality power. There are different software tools which can be used to develop power quality equipment [1], [2]. The prerequisite for follow up and checking of power quality is expanding and various diverse national standards and directions have been acquainted which give direction for what is to be viewed as great power quality [3], [4]. Power quality estimation and its continuous monitoring is a tedious and difficult task. Various non-linear loads create disturbances in many forms which not only affect the performance of instruments but also deteriorate the life of devices and instruments [5], [6], [7,],

[8]. This paper presents LabVIEW based power quality monitoring system which can be useful for mass of professionals and will be much economical if its .exe file is created. This executable file of power quality software based on LabVIEW can be made available for downloading and thus it can be used in free of cost. The aim of this paper is to compare the results obtained by this power quality software and by the present available power quality instrument. This comparison claims its importance and preference over conventional methods of power quality measurement and monitoring system.

The quality of electrical power may be described as a set of values of parameters, such as:

- Continuity of service
- Variation in voltage size
- Transient voltages and streams
- Harmonic content in the waveforms for AC power

Principle elements influencing power quality are:

1. Noise
2. Harmonics
3. Voltage Spikes
4. Power variable and so forth.

II- POWER QUALITY MEASUREMENT

The measurements of few parameters for checking whether the quality of power is good or not is most essential.

Some of these parameters are as follows.

- Voltage variation
- Power variation
- Unbalance
- Harmonics (THD)
- Frequency
- Accuracy and so on.

III- TOOLS AND SOFTWARES USED

LabVIEW

LabVIEW (short for Laboratory Virtual Instrument Engineering Workbench) is a system-design platform and development environment for a visual programming language from National Instruments.

LabVIEW is an exceptionally beneficial working environment for making custom applications that cooperate with genuine information or signs in fields, for example, science and designing. The net after effect of utilizing an apparatus, for example, LabVIEW is that higher quality ventures can be finished in less time with fewer individuals involved.

IV- INFERENCES DRAWN OUT OF THE LITERATURE REVIEW

The investigator after going through a large number of literatures divulges the following inferences:

- Power quality estimation is critical furthermore it is exceptionally hard to screen it appropriately round the clock.
- The types of equipment utilized for power quality estimation are exorbitant.
- Lots of sounds, clamors and different unsettling influences are continuously creating because of various loads and power gadgets.
- Low power quality diminishes the life of items, breaking down of gadgets and more power utilization.

- Power quality improvement is extremely perplexing procedure.
- Different channels, STATCOM and different gadgets/systems are utilized to enhance the quality of power.
- Power quality estimation and control is intense issue in homes and also in commercial enterprises.

V- PROPOSED WORK

The main objectives of this work are as follows:

1. To grow minimal effort elite power quality measuring hardware/technology.
2. To create programming based (NI LabVIEW) power quality estimation system so that the expense of gadgets might be diminished ordinarily and more proficient strategy might be produced.
3. To enhance power quality by lessening commotion by planning appropriate channel/mixes of channel in Labview.

VI- SOFTWARE DEVELOPED FOR POWER QUALITY MONITORING

The investigator has developed highly powerful software which can measure different power quality data like voltage, current, power, energy, total harmonic distortion etc. The GUI of the software is given below. The fig. 1 is the real picture of the hardware implementation with Arduino. At the same time the data has been measured using fluke instrument.

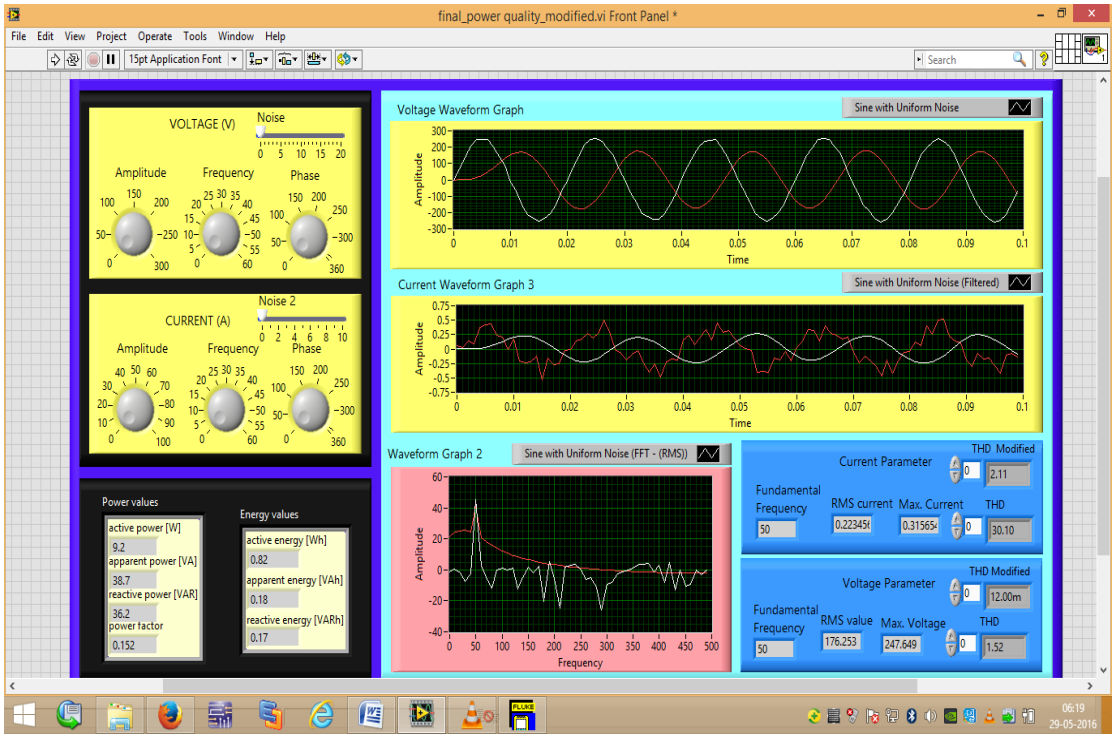

Fig. 1 Power Quality Analyzer Using Arduino

Fig.1 shows the front panel of real time realization of the hardware with the developed software by interfacing with arduino. All results like voltage current, frequency, power values, power factor, energy

alues and THD are being displayed on the screen of the LabVIEW front panel.

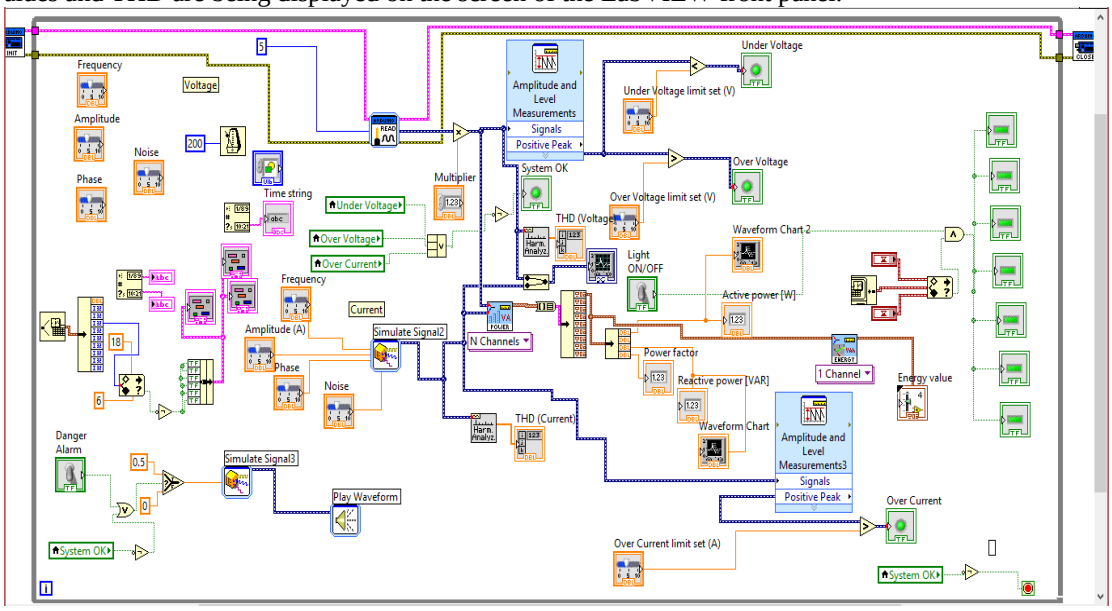

Fig. 2 Coding of Arduino for Power Quality Measurement

The LabVIEW coding for power quality measurement is shown in fig.2.

Power Quality Measurement by Fluke Instrument

The following fig.3 shows the voltage and current values measured by fluke power analyzer.

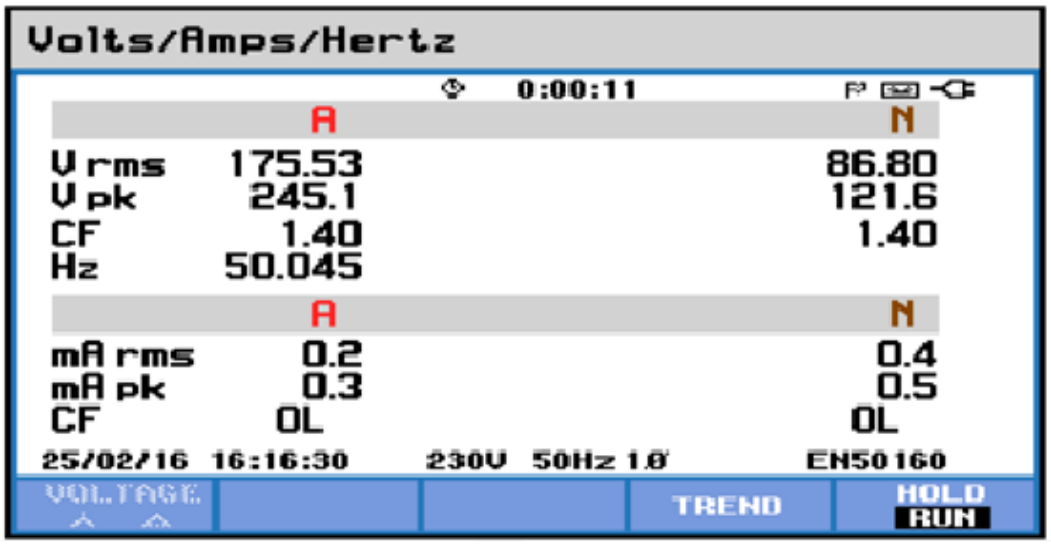

Fig. 3 Voltage and Current Measurement Using Fluke

The following fig.4 shows the power and energy values measured by fluke power analyzer.

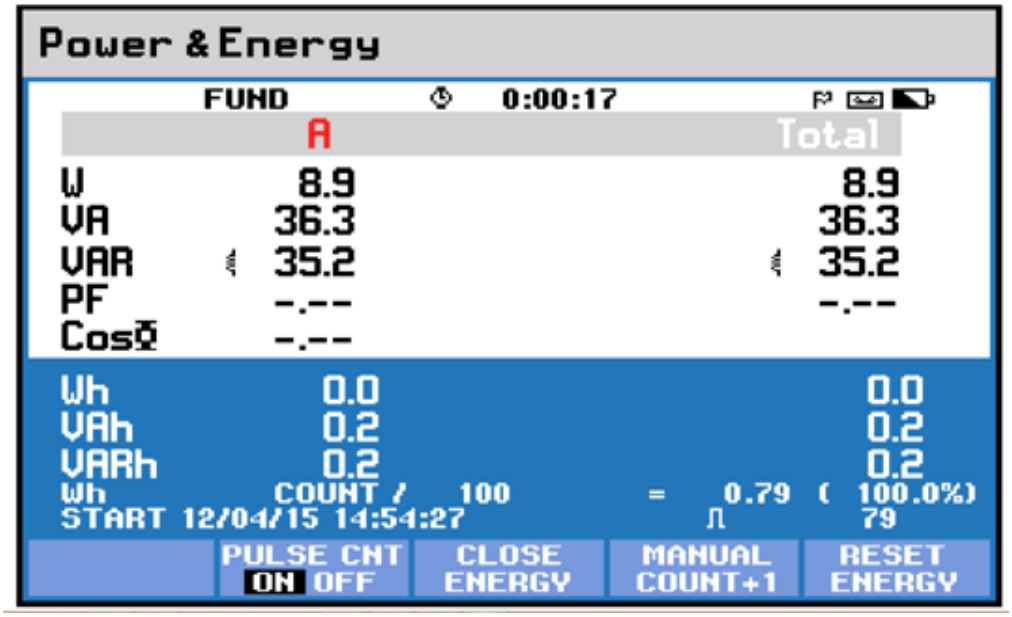

Fig. 4 Power and Energy Measurement Using Fluke

The measured THD in current by fluke power analyzer is shown in fig.5.

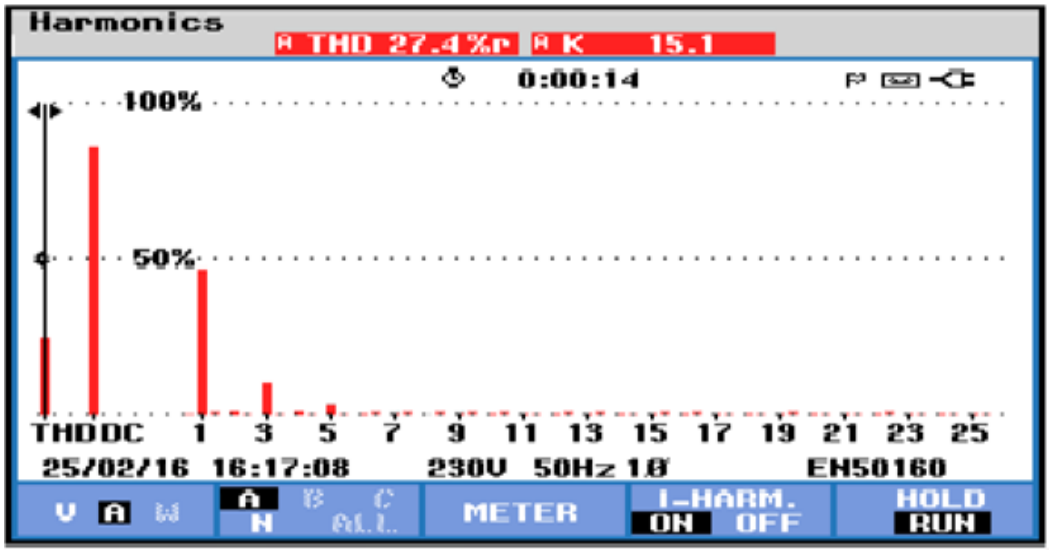

Fig. 5 THD Measured by Fluke Instrument

All the real time results taken from developed software and with fluke power analyzer are tabulated below in table 1, which validates the result obtained by developed power quality software.

Table 1. Comparison of Arduino and Fluke Data

S.N	Parameter	Fluke data	Arduino data	%Error	%Accuracy
1	V(Peak)	245.1	247.649	1.03998	98.96002
2	V(RMS)	175.53	176.253	0.4119	99.5881
3	THD Voltage (%)	1.3	1.52	16.9231	83.0769
4	THD Current(%)	26.9	30.10	11.8959	88.1041

5	Active Power(W)	8.7	9.2	5.74713	94.25287
6	Apparant power (VA)	36.3	38.7	6.61157	93.38843
7	Reactive power(VAR)	35.2	36.2	2.84091	97.15909
8	Power factor	0.149	0.152	2.01342	97.98658
9	Fundamental Frequency	50.045	50	0.089919	99.91008
10	Active Energy(Wh)	0.79	0.82	3.79747	96.20253
11	Apparant energy (VAh)	0.2	0.18	10	90
12	Reactive energy(VARh)	0.2	0.17	15	85

In table 1, the accuracy of the developed power quality software for all parameters measurement are calculated and shown. From the table 1, it is clear that all the parameters mentioned above are measured accurately which are validated with the data taken from fluke power quality analyzer. The hardware has been realized with the developed software using arduino for interfacing with labVIEW.

CONCLUSION

Dependability and consistency of power supply is a standout amongst the most imperative conditions for the exercises of modern and administration organizations. Issues beginning from poor Power Quality incorporate intrusions, symphonious contamination and so on. In this way the heaps associated with a system with such issues will fizzle, have a short lifetime and the productivity of the framework will diminish.

Observing the Power Quality will make conceivable to distinguish the sources/reasons for issues inside the end-client's system. The arrangement would be either expelling the source or making insusceptible the establishment from the poor power quality. Both arrangements typically cost far not exactly the potential harms that may infer.

The investigator has developed power quality monitoring system which monitors following quantities:

1. V (Peak)

2. V (RMS)

3. THD Voltages (%)

4. THD Current (%)

5. Active Power (W)

6. Apparent Power (VA)

7. Reactive Power (VAR)

8. Power Factor

9. Fundamental Frequencies

10. Active Energy(Wh)

11. Apparent Energy (VAh)

12. Reactive Energy (VARh)

The software developed is very useful and by interfacing it using ARDUINO, very low cost power quality monitoring system may be developed. Maximum accuracy of 99. 59% has been achieved. This is an excellent result obtained through this arduino based software.

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