INTERNATIONAL JOURNAL FOR TRENDS IN ENGINEERING & TECHNOLOGY
VOLUME 4 ISSUE 2 – APRIL 2015 - ISSN: 2349 - 9303

Design and Implementation of Low Cost Smart Web Sensors for Electric Power Quality Monitoring

Jayagayathri. K[1]
[1]PG Scholar, ME- EST, ACET,
gayathrikannan03@email.com

Mr. R. Sathish[2]
[2]Asst.Prof, ACET, EEE Department
sathishvcet@email.com

Abstract— The paper presents a low cost virtual instrument for monitoring the power quality events. The problem of power quality concerns the interferences which can be present in the mains. These electromagnetic disturbances can overcome a large interval of frequencies and can be present in industrial, domestic as well as commercial system .As main negative effects we can mention the high order harmonics, voltage fluctuations, flickers and disturbances with high slew-rates It is frequently indispensable to measure power quality indexes in wide electric power plant or in industrial zones. To this aim a low cost smart web sensors has been designed and implemented to acquire, process and transmit data over 802.3 network .It is organized in multi micro controller system. The first one dedicated to the data acquisition and the other to data processing, dynamic HTML pages construction and TCP/IP stack management. Key features of realized devices are low cost, data processing and remote communication capabilities, the possibility to provide data with any internet browser.

Index Terms— Power quality, power system transient, distortion, voltage measurement, signal analysis, smart web sensors

INTRODUCTION

In recent years the interference sources was widely spread in the mains. The PQ disturbances can be present in industrial, domestic as well as commercial systems. As main examples we can refer to electronic power control with non-linear components (e.g. PCs and industrial systems with speed- controlled drives). These systems are commonly used also in domestic appliances (e.g. television sets, economy lamps). The PQ disturbances can cover a large interval of frequencies. High order harmonics, voltage fluctuations and high frequency disturbances with slew-rates of some microseconds or less can be mentioned as main disturbances. In some cases the frequency and width of these voltage variations can produce a physiological irritating phenomenon due to luminance fluctuations of the lighting (flicker effect).

Power disturbances can produce many problems in electrical and electronic systems. Therefore in the last years the monitoring of the quality of supply networks has become an issue of international interest. The advent of technology has facilitated the development of small, low-power devices that combine programmable for general-purpose computing with multiple sensing and wireless communication capabilities. Composing these sensor nodes into sophisticated ad hoc computational and communication infrastructures to form sensor networks will have significant impact on the identification of electromagnetic disturbance sources.

To this aim a low-cost smart web sensor has designed and realized. It allows the implementation of distributed PQ measurement system in large industrial environments, by using standard internet browser. In the paper main thing is design; implementation and characterization *of* the proposed device are discussed in detail. The system, which complies with the IEC standards, has been characterized and the more significant experimental results concerning the on field application are also given.

Smart Meter:

Electricity sector faces new challenges which must be responded in a vision of future, so that the grid is upgraded to a smart grid. The grid adapts various technologies like telecommunication, information and data computing. When there is mismatch in power generation and demand in the grid, it causes the power shutdown and low voltage problems. Due to this the power quality gets reduced and life of the various gadgets connected to the power system gets reduced. so its regulated by this paper adapts LabVIEW environment to design the Smart meter control the priority scheduling of the load can carried out during peak load period. Using this design it provides continuous power to the load without power shortage.

A smart meter is usually an electrical meter that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing purposes. Smart meters enable two-way communication between the meter and the LabVIEW central system. Unlike home energy monitors, smart meters can gather data for remote reporting. Such an Advanced Metering Infrastructure (AMI) differs from traditional Automatic Meter Reading (AMR) in that it enables two-way communications with the meter. Smart Meters usually involve real-time or near real-time sensors, power outage notification, and power quality monitoring. These additional features are more than simple automated meter reading (AMR). They are similar in many respects to Advanced Metering Infrastructure (AMI) meters. Smart meters are also believed to be a less costly alternative to traditional interval or time-of-use meters and are intended to be used on a wide scale with all customer classes, including residential customers.

Process:

The interface with the low voltage distribution system requires: i) a galvanic insulation between the power circuit and the measuring circuit, in order to guarantee both the operator and measurement apparatus *safety;* ii) a good linearity; iii) a bandwidth suitable for the monitoring of fast transient events; iv) small dimensions and weight. As the voltage input transducer is concerned it is based on an active attenuator. It allows i) a nominal input voltage up to 600 Vrms; ii) an overall accuracy off 0.3%; %) a thermal drift <0..l%, iv) a linearity < 0.2% v) a slew rate of 10 V/ps.

The device must be able to measure some PQ parameters, in particular: voltage true rms amplitude, voltage peak Amplitude, voltage total harmonic distortion, amplitudes of the fundamental frequency component and of the most important harmonics. The input voltage acquisition should be performed without triggering, in order to avoid undesired acquisition gaps during fast transient events. Automatic data storage should be performed with a thresholds based.

Technique, with a references values set defined via shire. To optimize the system performance, increasing the measurement speed, we assigned the data acquisition, processing and communication tasks to different blocks: i) voltage peak detector; ii) true RMS to-dc converter; iii) input signal acquisition and preprocessing; iv) final data processing; iv) data transfer to the web site managing unit. The apparatus has been provided with a communication link to a host PC, for the testing operations. The peak detector is based on a full bridge rectifier circuit; the voltage drop across the diodes has been evaluated and automatically compensated by a software correction procedure.

The rms voltage measuring circuit is based on the MX536AKtrue rms-to-dc converter. It offers the following features: i)the rms measurements for both ac and dc signals; U) a bandwidth of 2 *MHz* for Vrmel V; iii) a low supply current of only 1.2 mA, iv) a total error of f2 mVf0.2% of reading's) an input signal range from 0 to 7 Vrms with *15V Supply ;vi) an input resistance of 1 O O M n

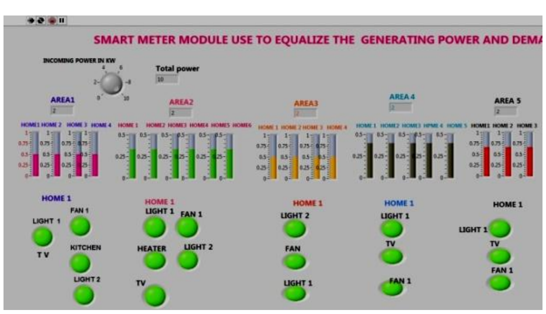

Fig.1 - The electrical circuits of the RMS to & and the peak to dc converters.

The data acquisition unity is based on a microcontroller, the Microchip PIC16F877. It performs the following operations: i) continuous sampling, without triggering, of the outputs from the voltage transducer, the peak detector and the RMS to dc-converter; ii) A/D conversion with a 10-bit vertical resolution; iii) preprocessing of acquired raw data; iv) data transfer to the web site managing unit; v) communication with the host PC during the apparatus testing.

The processing and communication unit is based on the80152 microcontroller. It carries out the final data processing and performs the results visualization by means of regeneration of the HTML pages in the web server. It also performs the control of the TCPAP communication. For the proposed hardware architecture a total cost of about 300 € is realistic.

The Control, Measurement and Testing:

The proposed smart web sensor requires the developing of software for three different tasks: i) the control of data acquisition, ii) the processing of raw data, iii) the transfer of measurement results via TCPAF'. The data acquisition control is performed by the PIC16F877 microcontroller, programmed in the Assembler language. The implemented software performs the control for the sampling rate, the input channel scanning and the digital output. A RS-232 standard communication port has been used for the testing of the microcontroller performance by means of a host computer. Both the raw data processing and communication are performed by the 80152 microcontroller. It has been programmed in the Dynamic C, mainly because of the availability of many standard libraries. The measurement of the harmonic content of the acquired harmonic content of the acquired voltage has been implemented according to the EN 61000 4-7 standard, using the FFT-based approach.

In detail, the data acquisition system has been configured using the following parameters: *i) a* sampling rate of 12.8 B, ii) an acquired window width of 320ms, equivalent at 16 cycles of the *50Hz* fundamental frequency; iii) a rectangular window; iv) no gap and overlapping between successive windows; v) a frequency resolution of 3.125 *Hz.* The described features make possible the simultaneous measurement of quasi-stationary and fluctuating harmonics, inter-harmonics and spurious components.

The voltage total harmonic distortion index (VTHD%) is also evaluated. The actual version of this carries out the measurement of the VTHDYO, the am litotes of respectively the fundamental frequency, the 3,*5&* and 7& order harmonics [10,11,12]. Both the peak and rams values are acquired with the described sampling rate, with at *of* 78 *ps.* The peak value can be used as a fast index for the evaluation of transient disturbances. The rms value is helpful in the evaluation of Me rent kinds of disturbances: i) voltage short dips, with a width of less than one period of the fundamental frequency and a voltage shape distortion; ii) voltage long dips, with a width of more than one period, without a voltage shape distortion; iii) voltage flicker.

INTERNATIONAL JOURNAL FOR TRENDS IN ENGINEERING & TECHNOLOGY
VOLUME 4 ISSUE 2 – APRIL 2015 - ISSN: 2349 - 9303

A first approach to the flicker evaluation may be performed by means of the relative voltage change that is the difference of any successive values of the rms voltage. The testing of the data acquisition and processing has required the carrying out of three measurement testing programs, respectively for the testing of the measurement of peak and nns voltages, VTHD% and harmonic amplitudes.

As the web interface is concerned, our most important aim has been the possibility of loading the page using the widely adopted web browsers, such as Internet Explorer and Netscape. In the HTML page the measured quantities are stored on HTML variables. When the web browser receives a refresh command, *a* new HTML variable set generated by 80152 micro-controller.

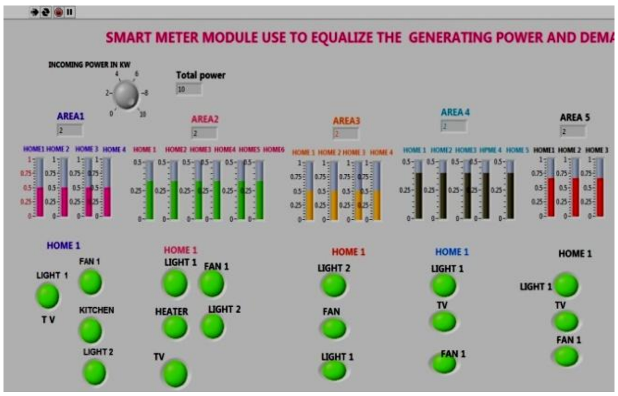

Fig 2. (Front panel of At unbalanced power and demand LabVIEW model)

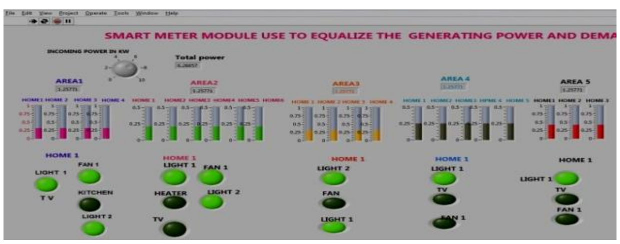

Fig 3. (front panel of at minimum incoming power LabVIEW model)

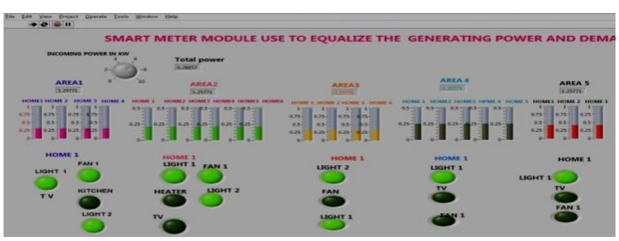

Fig 4. (front Panel of LabVIEW model (At Balanced power and demand)

System characterization and Experimental results:

The system characterization has been performed for the rms voltage measurement, the peak voltage measurement and the VTHD% evaluation .With reference to the instrumentation, the Keithley 2001 multimeter has been used for the measurement of both peak and rms reference voltages. To check the system performances related to the measurement of both total harmonic distortion and harmonic components we generated the reference voltage signal by means of the Tektronix AWG 2005 arbitrary waveform generator and the Kenco BOP 1000 power amplifier. To verify the performance with an input voltage affected by transient disturbances, we generated the reference signal with the EMC Partner Transient 2000.

Tab.1 - Vrms value measurement error for different values of input voltage.

Reference Vrms [Vrms]	Measured Vrms [Vrms]	Relative error [%]
179.2	176.8	1.34
189.6	188.0	0.84
199.2	198.4	0.40
209.6	208.0	0.76
219.7	218.4	0.59
229.6	228.0	0.69
239.2	238.4	0.33
249.6	250.4	0.32
260.1	258.4	0.65

Tab.2 - Peak value measurement error for different values of input voltage.

Reference Peak [V]	Measured Peak [V]	Relative error [%]
254.4	256.0	0.63
269.6	271.2	0.59
282.4	284.0	0.56
297.6	297.9	0.10
311.2	312.0	0.26
325.6	324.8	0.24
339.7	339.2	0.14
354.4	352.8	0.45
368.8	367.2	0.43

Tab.3 – Vtdh measurement for different value of distortion

Reference VTHD [%]	Measured VTHD [%]	Relative error [%]
1.09	1.07	1.83
2.08	2.05	1.44
3.11	3.07	1.29
4.12	4.07	1.21
5.10	5.05	0.98
6.09	6.04	0.82
7.06	7.00	0.85
8.10	8.04	0.74
9.15	9.09	0.65
10.19	10.13	0.59

ACKNOWLEDGEMENT

I thank my friends everyone who gave me support with various ideas and interesting factors regarding project. And also I thank my guide Mr..R.Sathish ,who helped me in various aspects of my project.

CONCLUSIONS

In this paper a smart web sensor for power quality monitoring has been proposed. It performs the evaluation of some important power quality indexes in the low voltage mains, and the data storage and communication via TCP as a web server. Its main advantages are: a simple hardware architecture, a low cost and a wide connection capability. Both the hardware and software architectures have been implemented according to the IEC @U) standards related to harmonics measurements. The systems characterization has been performed, with satisfactory results according to the features of the system.

REFERENCES

[1] J.AniUaga, D.A.Bradley, P.S.Bodger, Power System Harmonics, John Wiley & Sons, 1985.

[2] J.Arrillaga, L.LEguiluz, Armdnicos en sisremas de potencia, Press of the University of cantabria, 1994.

[3] J.Arrillaga, L.LEguiluz, Armdnicos en sisremas de potencia, Press of the University of cantabria, 1994.

[4] EN 61000-4-15 - Flickermeter - Functional and design specijkatiom.

[5] EN 61000-3-3 - Limitation of voltage fluctuations and flicker in low voltage suppry systems with rated current. 1997-06.

[6] EN 50160 - Voltage characteristics of elecm.cify supplied by public distribution systems. March 2000.

[7] G.Bucci E.Fiorucci C.Landi, G. O m : “The Use of Wireless Networkfor Distributed Measurement Applications”, IEEE I”tation and Measurement Technology Conference, Anchorage, May, 2002.

[8] A.BaccigaIupi, C.Lmdi: ”Programmable miCrocontroIlers for real-time variable for measurements”. Porceeding of XXW ANIPLA conference on 2013.

[9] G.Bucci, C. De Capua, C. Lmdi, “Power Measurements on High Distorted on Signals: Experimental Comparison Between T w Alternative Developed Device Solutions”.

[10] G. Bucci C. Laadi, “On-Line Digaal Measurements forQualityAnalysis of Power Systems Under the various Non- Sinusoidal conditions”,ZEEETrans. On. I&M. Vol. 48, n.6, Aug. 1999.