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Quality Control System of Electric Energy

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Abstract

The main purpose of the research is to determine the quality of electrical energy and to create a control system for them through modern technologies. The parameters describing electrical energy and the effects of these parameters on energy quality were studied, ways of eliminating the negative effects of the main parameters on energy quality were investigated. A quality control system has been created using GPRS and WEB-based technologies, as well as LabVIEW software.

Keywords

Electrical Energy, Energy Quality, Electricity Quality, Random Error, Systematic Error, Monitoring System, Control system, LabVIEW Software, Virtual Device

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1. Introduction

High-quality electricity is at any point in the network, minimizing the amplitude and frequency of tension, and the tension in the form of a sinusoidal wave. In contrast, the amplitude of tension, tension dance, sudden shimmering, wave sinusoidal form, and frequency change are poor quality. For this purpose, there is a large number of exploitation and facilities designed to improve energy quality in the activities undertaken by project facilities. This requires additional capital. The quality of electrical energy used has a significant impact on the economic performance and reliability of industrial enterprises and electrical networks. In other words, low-power electric power delivers valuable technological equipment, leads to large quantities of waste products and leads to other severe consequences.

The equipment must meet the same requirements, with the accuracy class and the accuracy of the measuring range. These devices confirm the need for correct information to manage energy quality. Improving the quality of electrical energy is one of the main problems, because the quality of electricity is mainly affected by energy consumption, energy transfer systems, uninterrupted operation of technological processes and similar features. Electricity quality or simply energy quality refers to the utility of electrical energy to consumer installations, which "refers to the nominal amount and frequency tension and the energy distribution of the current to the sinusoidal waveforms". From the concept of time - to describe electrical energy that manages an electric charge [1, 4].

"Energy quality" is, in fact, the quality of tension greater than the energy or electricity flow described in this term. The power is simply the flow of energy and the current required in the load can not be controlled.

Electricity quality can be described by a number of parameters:

1. interoperability of the service;
2. Changes in tension volumes;
3. Transition voltages and currents;
4. Harmonic distortion in waveforms for the power of the variable current.

The processes in electrical circuits can be characterized by the use of three main physical quantities therein. These three quantities characterize the energy source from the one hand

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on the one hand, on the other hand, the energy converted from the form of electricity to another energy type, and the energy transmitted to the third party from the source. The development of electronics has led to the use of electrical engine regulators in technological processes, welding engines in systems such as oilfields. The characteristic features of these workers change the nature of the energy source of the food source. The key indicators that ensure the normal functioning of power consumers in food circuits in single-phase electrical networks are as follows:

- frequency tendencies,

- tension inclinations,

- amplitude of frequency fluctuations,

- sinusoidal coefficient of tension and so on.

Low cost solution of the problem of electromagnetic compatibility requires identification and maintenance of optimal quality indicators of electricity within the condition of providing technical specifications. The following problems are to be considered in improving the quality of electricity:

- economic problems;

- Mathematical problems;

- technical problems.

High electric power quality requires the development of new methods of studying the effects of the network on feedstock consumers. The main difficulties are the absence of any devices in electrical networks, and therefore, changing the measurement methods. This is largely due to chaotic shifts in cargo, and requires the use of statistical and statistical methods of statistical methods and results.

2. Statement of the Problem

One of the most important indicators of electricity is the change in the price of phase and line voltage. The voltage tension is taken as ΔV as the difference between the nominal voltage of the network and the tension at the time of administration:

$$\Delta V = V - V_{nom.} \quad (1)$$

or expressed in %

$$\Delta V = \frac{V - V_{nom}}{V_{nom}} 100\% \quad (2)$$

is determined by means of expressions.

Depending on the type of power consumers, some western countries have the following tension inclinations:

I. Possibility of electric motors and their elements (-5%, + 10%);

II. In factories, workshops, lighting devices in all service buildings, food tensions (-2.5%, +5%);

III. ± 5% in other feeders, animal feeding houses, poultry and lighting nets. In the post-accident regimes, the tension can be reduced by 5% in addition.

The first indication of the energy quality problem is changes in the amplitude or amplitude level of the tension waveform of the sinusoidal wave energy source. Harmonics or tension in the tone, and food-borne events can lead to problems. The problem can turn a period of time in tension (milliseconds) to big times (clockwise). The purpose of the correction method is to meet the energy source's international standards. Energy quality problems can begin with four phases of the system, which is mostly powered by electricity. The first includes a power plant and a system of all transmitters. Secondly, transmission lines, mainly transformer centers, primary and secondary power lines. The third is distribution transformers. The latter, namely the fourth service equipment and lines. In addition, problems may be related to powered equipment (eg power-to-transformers). Reduces the time and frequency of linear-voltage disruptions at every stage of the power supply system.

The control device can not be restored when there is a network voltage drop, when the sensitivity of the rails is lower than normal, or if there are logic circuits provided by the power supply of the internal switchgear. The term energy quality is applied to many types of electromagnetic phenomena in the energy system. The increased use of electronic devices has increased the interest in energy quality in recent years, and the development of a specific term to describe these events has also pushed. Energy quality monitoring is a process of gathering some data on voltages and currents; To transmit these data to a useful place and to turn them into decision-making information. Any electrical problem is caused by the voltage, current or malfunction of the customer equipment [2, 3, 5].

The elimination of stagnation in industrial production and its development in the Republic are organically linked to the efficient functioning of power plants. The efficient work of the electro-energy facilities, in turn, depends largely on the fact that the equipment that forms the basis of these facilities meets the requirements of world standards, and the application of automated and automated technical systems based on the application of modern information technologies. It is well-known that one of the main factors of the general operation principle of the electroenergetic facilities is the operational control of the technological process itself and also the operational characteristics of the object and the product characterizing the product in the finished product realization. The use of control and diagnostic systems based on the application of transmitters and transducers that meet modern requirements in the electronics industry not only determines whether the finished product is in compliance with the standards, but also localization of unwanted trends in technological processes and their timely prevention based on output performance indicators.

Initial parameter converter is one of the key elements of automated control and diagnostic systems designed for power plants, as well as technical tools that directly affect the precision of the systems.

The internal parameters of the circuit elements lead to errors in electrical and non-electrical quantities. The internal parameters of the measuring devices should be subject to special conditions in order to prevent a change in the working regime. It is inevitable that the system's operating modes change when the measuring devices are activated. The measurement results of the devices are called the error of measuring this effect. Measurement data is generated in the case of electric motors during unmanned and short circuit, characterized by their basic technical and economic performance, allowing to predict technical equipment and technological process, and evaluate their technical condition. Therefore, the results of I, U, P measurements for quality control of EMs, which are used to make full use of non-free operation and short-circuit indicators, determination of defective product, diagnostics, static processing, quality management The time is analyzed in detail. This situation requires high performance performance of the electric motors' unloading and short-circuit measuring systems and vehicles.

3. Solution of the Problem

Numerical measuring instruments and methods of integral parameters of changing current signals have developed considerably over the last few years. However, the achievements achieved in this field are relatively small compared to the successes achieved in the measurement of the parameters of variable vibration signals and measurement systems. This is due to a number of methodological and technical problems encountered during the digital measurement of the integral parameters of the variable current signals. One of the most important aspects in the development of power transmitters and transducers is the measurement of power in the conditions of non-sinusoidal signals. Extensive use of non-linear elements in electronic and electrical equipments is the main reason for harmonic distortions in linear operators (voltage and current lines). Numerous studies have been carried out in this regard and scientific research works have been carried out that are accurate to the analysis of effective methods for determination of electrical parameters in non-sinusoidal circuits.

One of the important issues that arises in the conditions of non-sinusoidal signals is due to an accurate assessment of the period of input signals. Thus, during the integration of sudden power, the process of integrating is taken as the output of the nT. Where T is the repetition period for the input signal (voltage or current), and n is the integer ($n = \overline{1, m}$). There is an error due to the difference of n from the integer. This error, known as "spectral leakage" from the area of discrete processing of signals, can be corrected in different ways. In practice, the various methods of electrical measurements are different. Alternatively, they can be divided into flat and indirect measurements. When using the direct valuation method, the price of the measured value is directly assigned by the device. For example, measuring current - ampermeter, tension - voltmeter, etc. If the measured quantity is determined by counting the instructions of several devices, this is an indirect measure, for example, based on the ampermeter and voltmeter instructions:

$$P = \frac{1}{M}\sum_{j=1}^{M} U_j^* \cdot I_j^*$$

If we take into account the errors that occurred during the measurement of tension and current, it is as follows:

$$U_j^* = U_j + \varepsilon_j$$

$$\varepsilon_j = \overline{\varepsilon_j} + \varepsilon_j^0$$

$$I_j^* = I_j + \gamma_j$$

$$\gamma_j = \overline{\gamma_j} + \gamma_j^0$$

At this time, the relatively high price collectors are aware of the seriousness of the error. Variable current signals are non-sinusoidal because of the reason given above.

$$P = \frac{1}{M}\sum_{j=1}^{M} U_j^* \cdot I_j^* = \frac{1}{M}\sum_{j=1}^{M}\left(U_j + \varepsilon_j\right)\cdot\left(I_j + \gamma_j\right) =$$

$$= \frac{1}{M}\sum_{j=1}^{M}\left(U_j + \overline{\varepsilon_j} + \varepsilon_j^0\right)\cdot\left(I_j + \overline{\gamma_j} + \gamma_j^0\right) =$$

$$= \frac{1}{M}\sum_{j=1}^{M} U_j I_j + U_j\overline{\gamma_j} + U_j\gamma_j^0 + \overline{\varepsilon_j} I_j + \overline{\varepsilon_j}\overline{\gamma_j} + \overline{\varepsilon_j}\gamma_j^0 + \varepsilon_j^0 I_j + \varepsilon_j^0\overline{\gamma_j} + \varepsilon_j^0\gamma_j^0$$

By examining the practice using the Matlab software package, it is possible to see the non-sinusoidal signal as shown in Figure 1 and 2, by adding random and statistical errors to the sinusoidal signal.

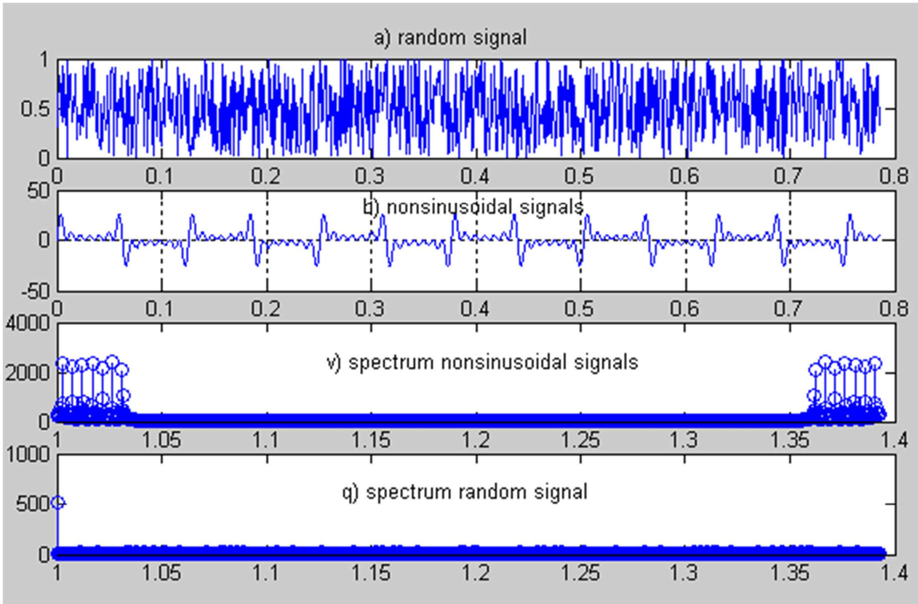

Figure 1. Random error non-sinusoidal signal.

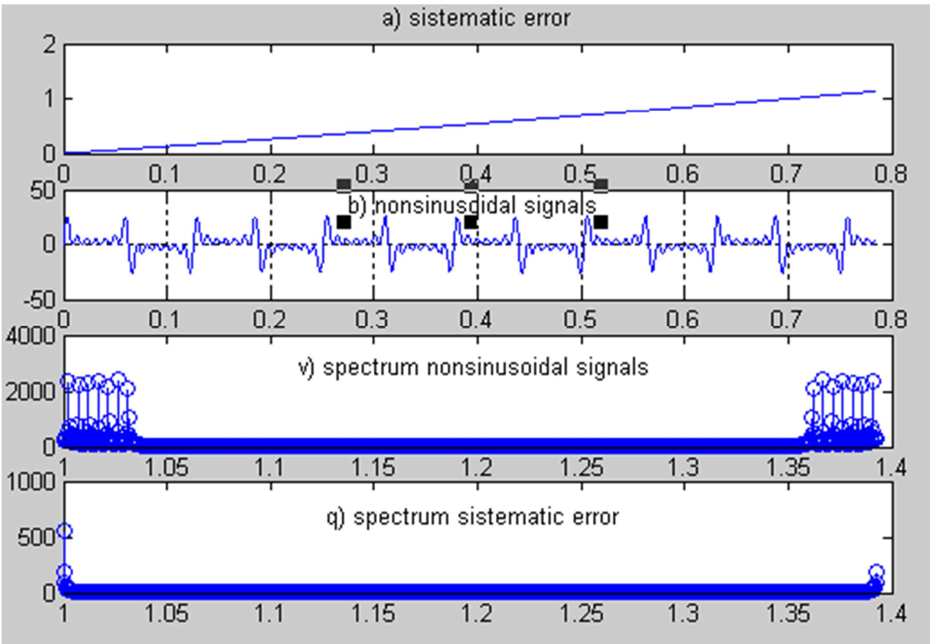

Figure 2. Systematic error non-sinusoidal signal.

The dancing of the tension (swing) changes when motors and other electrical receivers have enough power, when short circuit occurs, when there are very variable loads and so on. As a result of increased tension in the network due to large currents. Distortion distortions have a negative impact on the operation of electrical receivers and worsen the operation of the radios. For lighting devices and radiocytes, GOST 13109-67, for the calculation of the density of dance densities of their clamps, the following formula has been adopted:

$$V_t = 1 + \frac{6}{n} = 1 + \frac{\Delta t}{10}, \quad \%$$

Where n is the frequency of dance per hour, Δt is the intermediate time interval between dance.

If tension dances are more than the actual values that can be released, then appropriate measures should be taken to avoid it. It is advisable to implement energy quality monitoring using online monitoring. This technology is powered by the use of power quality measuring devices, and is monitored by the use of client computers, web servers, energy databases and communications networks [6-9].

Using the LabVIEW software, you can build the systems for energy quality monitoring by means of virtual tools. These systems are a simple, intelligent and other industrial tool that includes software and hardware. To assess the quality of the power better, the 3-layered online energy tracking system (PQMS), which uses the General Packet Radio Service (GPRS) wireless network, is offered as a communication channel. This PQMS consists of 3 sections: Energy Quality Monitor (PQM), Basic Computer Monitoring Software (MS) and Web Platform (WP). Designed based on DSP (Digital Signal Processor) and CPLD (Complex Programming Logic), PQM provides real-time and accurate monitoring. Then, MS collects and analyzes tracking data. At the same time, the GPRS network provides a communication channel for PQM, and provides WP tracking data and analysis results over the Internet and supervises the quality of energy from remote locations. Due to the large number of changes made to the Internet, the WWW is used as a means to access data. The WWW provides a mechanism for "looking" away from these three types of web page HTML "language" and HTTP application protocols.

Non-regeneration and reorganization of the electricity industry alter how consumers perceive energy quality monitoring. Drantez-BMI has produced the first PQ monitor, which was a microprocessor-based monitor analyzer without graphics in the mid-1970s. In recent years, rapid advances in semiconductor technology have increased performance and lowered the cost of PQ monitors. All of these tools are used together with data acquisition, data processing, and software submission and communication capabilities. These devices can simply record waveforms and use the software to collect data and track tracking results, including tension profiles and harmonic distortion information [10].

A new DSP based PQ tracking tool has been proposed to apply intelligent PQ tracking that can process correction measurements and provide useful information for PQ diagnostics.

The IEEE Standards documents have been developed on the basis of the IEEE Standards Committee and the Technical Committees of the Standards Coordination Committees. The IEEE-based Standards Institute represents the unanimity of wide-ranging expertise in activities involving the development of standards outside of IEEE.

An Internet-based power quality tracking system has been developed for remote control and analysis of energy quality. The main features of the system are:

1. Provides GPS-based power quality measuring devices (PQM) to simulate simultaneous data simultaneously;
2. Gathers, stores, and manages the quality data generated by the PGMs, and manages the site-managed database management software;
3. Provides productive and easy-to-use methods for connecting to different sites and data centers and provides the ability to send information from different sites via the Internet;
4. Provides computer-based explorer client software that provides relatively easy and fast access to the Greater VB and enables powerful statistical controls to analyze and record that data.

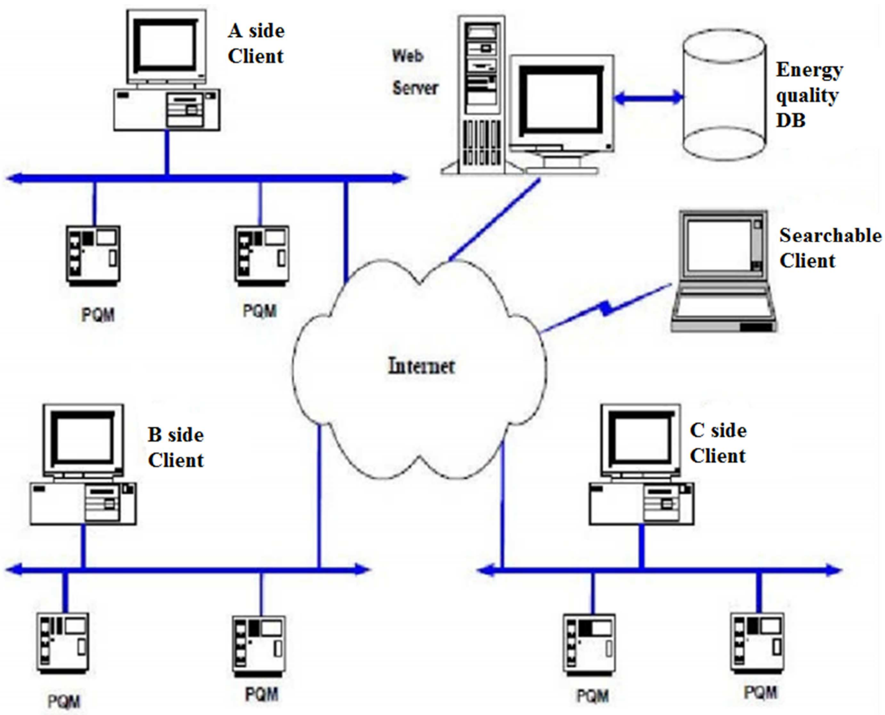

Figure 3. Internet based energy quality monitoring system.

As far as PQMs and the tool's network interface can be distant, no factor limits the geographical distribution of these tools. For example, while the tools are in the data center, interfaces can be in remote areas.

Additionally, this approach to system design allows the PSCs to monitor the data center and thus allows remote devices to interact with the data center. These "servers" and "clientele" are dynamically combined for a certain period of time, and then they have a power quality system and then interconnected web-type model. This step is a requirement for the Internet based energy quality tracking system. Figure 3 illustrates an internet based energy quality monitoring system.

The energy quality tracking system is a collection of web servers, computers, communications networks, and custom PGM technologies. The key feature of an energy quality tracking system is that it can transmit high quality data over a communication line. Critical features include data collection, processing, submission, and reporting. The energy quality monitoring system has been developed using a set of key components. They incorporate PACs, Client Computers, Web Server, and Power Quality VBs and Connectivity Networks. PQMs are connected to the power system via current and voltage transformers. These instruments are constantly pointing to voltage and current waveforms at solutions of up to 1024 at each time. PQM is an electrical power measuring device that forms the voltage and current waves. Figure 4 shows the basic elements of the PQM system.

A 3-layered online power quality tracking system (PQMS) utilizing the General Packet Radio Service (GPRS) wireless network is used as a communication channel to better estimate energy quality. This PQMS consists of 3 sections: Power Quality Monitor (PQM), Basic Computer Tracking Software (MS), and Web Platform (WP). MS collects and analyzes tracking data, while GPRS provides a communication channel for PQM and MS. WP provides tracking data and analysis results via the Internet, and supervisors can monitor and manage energy quality over long distances.

Together with the HTTP application protocol, the HTML language has been remotely attached to these documents. Virtual Instruments: A virtual instrument means to integrate the bracelet application's computer sources with the hardware through the application software. As a result, strong knowledge is combined with the ability to calculate, measure, and manage the devices.

Virtual tools have the following special advantages:

1. Enriched and improved the functionality of traditional tools;
2. Supplies supplied by the consumer;
3. A tool for recording software content;
4. Open industrial standard;
5. Facilitate complex testing systems.

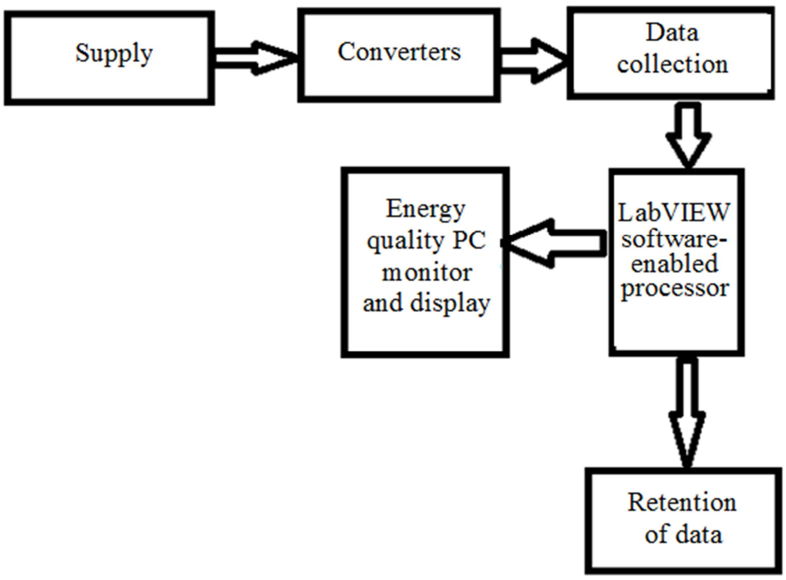

Figure 4. Main elements of the PQM system.

Currently, real-time energy quality monitoring is being done, and more challenges are needed for today's problems. The solution to this problem is achieved by applying a simple energy quality tracking system. The progress is based on software that uses graphical programming to work with a compatible hardware to create a compact station for energy quality monitoring without the use of different devices from different vendors. This device especially serves to detect malfunctions or distortions in the power line and transmit signals. Software National Instruments (NI) has been developed and developed using the graphical programming language called LabVIEW, USA. The solution to this problem is achieved by using a simple energy quality tracking system. Interface equipment has been provided with some additional and basic equipment supply. LabVIEW has been deployed, and a virtual tool has been created. As a result of the experiments, positive results were obtained. Figure 5 shows the front of the "device" created in the LabVIEW software.

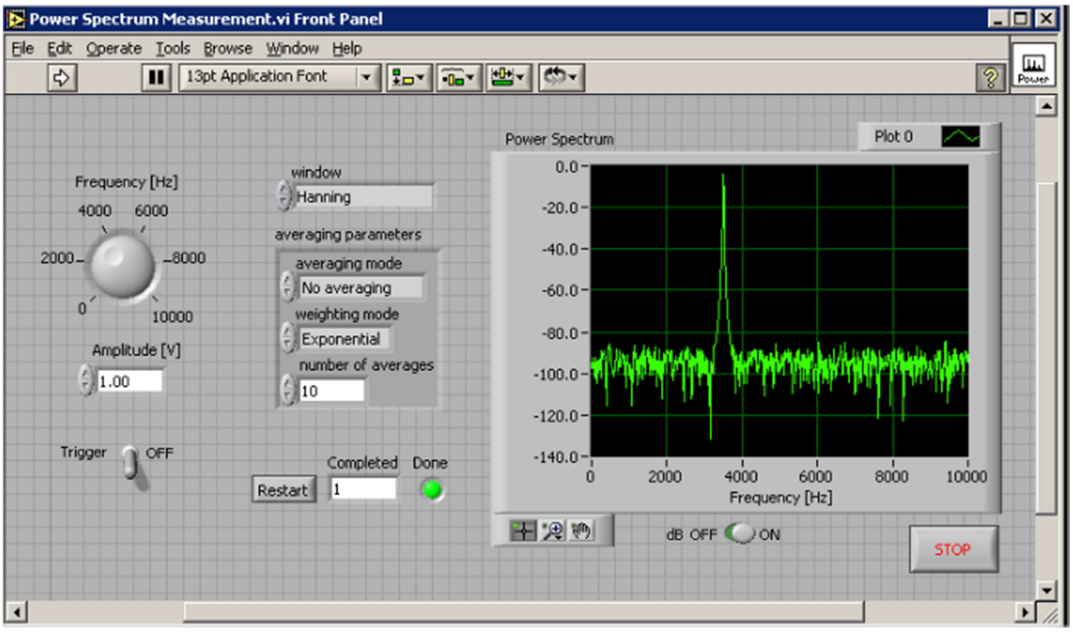

Figure 5. Virtual device front panel.

4. Conclusions

The results of the research have shown that the energy quality in the power grid is characterized by many parameters, the most important of which are tension inclinations, variations, frequency tendencies, harmonics, and so on. Can be shown; It's equivalent to improving the quality of the tension and solving the harmonics there, and in many ways, the yard is the most effective way to filter out; By utilizing Web technologies, manufacturers and consumers will be informed of the quality of their electricity and can carry out remote control of the process; Such systems allow the existing system to upgrade and enhance its functionality without creating a new control system, collects, memorizes and processes data. It also minimizes the system's cost savings by using data protection with minimal equipment.

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