POWER QUALITY AND ITS MONITORING WITH USING A SPECIAL TECHNIQUE

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Abstract: Today's power quality is a important point in the power engineering, Most of the modern industrial power quality monitoring systems are used for pre-fault alarming and load flow analysis. We show that a special Artificial network model for intelligent utilization of power for monitoring the power quality. Online monitoring of voltage and current of network there are in all time and can after preprocessing of Harmonics and waveform abnormalities. The performance of the proposed method is evaluated by comparing the test results with the actual expected values.

Keywords: Power Quality, Intelligent, Agent, Monitoring, ION

I. INTRODUCTION

With the increasing usage of power electronic devices and sensitive loads in power systems, power quality has attracted the attention of power engineers over the past years. To improve electric power quality, many power electronic based power quality conditioners are design and developed. Those conditioners include Active, Static Var Compensator (SVC), Static Synchronous Compensators (STATCOM) and Dynamic Voltage Restorer (DVR) [1], [2]. However, these conditioners be designed to solve a local power quality problem, which is caused by a large industry load, and already known to the system. To solve a system-wide power quality problem, the first step is to build a system wide power quality monitoring and assessment traditionally; client-server architecture is employed in a power quality monitoring system. The clients have the functions of data acquisition, data analysis (Fourier transform, and power quality index calculation). Those raw data and some processed data then transferred into the server. Based on its knowledge of the system topology, the server will give a system-wide power quality analysis (harmonic load flow, and locating power quality sources), and present results to the operators. However, the architecture has the disadvantages of high network bandwidth, and requirement of extremely large data storage and computation time. Modern complex manufacturing systems rely heavily on Computer Numerical Controlled (CNC) machines; variable speed drives and robotic devices, which often require a high reliability from the incoming electricity supply. Due to the widespread usage of non-linear loads, there has been a significant increase in the harmonic content of the 3-phase supply, raising serious power quality issues. An attempt made for classification of harmonics and abnormal waveforms using special artificial Networks. Among the commonly used neural network models, Self-Organizing Maps (SOM) is reputed for the pattern classification. Lastly for know of power quality we should monitoring power quality. In this paper, we investigate the power quality control methods and present a special method for this work. [3]

II. POWER QUALITY

The interest in power quality has increased during the latest years. A power quality problem can be defined: problem due to frequency, voltage regulation, voltage dips, flicker, transients, harmonics, and power factor and 3 phase imbalance". All machines affect the grid by the production of harmonics, voltage variations or by their power factors. At the same time the machines is increasing rapidly and thereby the power quality is being further affect. Transients or other irregularities in the feeding voltage can disturb machine drives. The drives may as well disturb the network voltage by the production of harmonics, load changes and varying power factor. The harmonic content and magnitude existing in any power system is largely unpredictable, and their effects will vary widely in different parts of the same system due to varying effects of different frequencies. Since the distorted wave is in the supply system, harmonic effects may occur at any point on the system where the distorted waveform exists. This occurrence is not limited to the immediate vicinity of the harmonic producing device. When power is converted to direct current or some other frequency, harmonics will exist in any distorted alternating component of the converted power. Harmonics may be transferred from one circuit or system to other by direct connection or by inductive or capacitive coupling. Harmonics of 50 Hz are in the low frequency audio range, the transfer of these frequencies into communication, signaling, and control circuits employing frequencies in the same range may cause unacceptable interference. In addition, harmonic currents circulating within a power circuit reduce the capacity o the current carrying equipment and increase losses without providing any useful work. Conventional power monitoring systems are capable of identifying most of the power quality issues as well as classification of harmonics and abnormal waveforms. To further argument robustness in monitoring and to improving performance during worst conditions, the use of neural networks as an alternative method for classification of the various types of harmonics and abnormal waveforms if proposed. [3]

II. INTELLIGENT SYSTEMS

Researchers of artificial intelligence have traditionally defined intelligence as an inherent property of a machine. An intelligent machine (or system) is viewed as one that has some computational capacity to act like a human, that is, “think” humanly, or “act” rationally, or “think” rationally (Russel, 1985). Hence, computational metrics of intelligence are traditionally expected to measure how well a machine performs like a human, for example, like a chess master, or like an expert diagnostician. We believe that such thinking-like-human approaches trying to mimic the way a mind operates are not technically feasible with current engineering capabilities. First, the complexities of human brain make simulation impossible using existing technology. The latest Intel Pentium IV processor integrates 55 million transistors, much less, than the 100 billion neurons and 100 trillion synaptic junctions found in a person’s brain. Second, the basic processing unit in a computer system, the transistor, is identical throughout a processor and can only handle two numbers, zero and one. On the other hand, neurons are diversified and are capable of processing subtle electrochemical signals efficiently in numerous possible ways. Third, humans as complex biological systems are the result of millions of years of natural selection. Many species coexist but only humans have emerged as intelligent creatures (in a full sense of the word). Moreover, certainly part of their story is found in language and their capacity to form complex cultural and technical artifacts and social institutions. We think of intelligence as an advanced functionality of system. Based on the discussion above it is quite clear that this type of functionality should be independent of a machine’s internal implementation details. We propose that this functionality is a function of the interface (human machine, machine-machine); to be found in the subject-to subject relation vis a vis the object, that is, the computer or intelligent machine. In order for the intelligent functionality to be something, observable (measurable), the intelligence of a system ought to be judged based on a system’s response to provided inputs. The internal structure and implementation may be not so important for observing it. However, is it possible to measure intelligence quantitatively? We believe that the answer ought to be yes; else, we run the risk of viewing machine intelligence as something metaphysical, mysterious and therefore not amenable to investigation. Methodologically, we know that it is very hard to quantify machine intelligence. The reason is that any intelligence measure has to be an overall performance index involving many detailed measures. For example, an intelligent person may be extraordinarily good at math but very poor in music. For another person the opposite may be true (capable in music but incapable at math). Obviously, there is no single number that can is used to characterize the difference between these two persons. Human IQ tests, have been criticized for their non-typicality, unreliability and inconsistency. The incommensurability of intelligence is a barrier we have to face with intelligent machines as well; and not only because they are used or they are better at different things. Evidently, different humans make for very different intelligent machines. Despite all these difficulties, defining performance metrics for intelligent systems is a worthy goal. People realize that the long lack of universally acceptable measures has seriously hampered the process of intelligent systems development. Science and technology have advanced by cooperation and competition. The root of cooperation and competition is a common ground with which results of different researchers can be compared. Comparisons are impossible without agreement on performance metrics. [4], [5]

VI. POWER QUALITY MONITORING SYSTEMS BASED ON MULTI AGENT SYSTEMS

Multi agent Systems over client server systems, a novel architecture based on Multi agent Systems can largely improve the performance of power quality monitoring systems. For example, the architecture can be used in the power quality monitoring systems for Navy all electric ship. The conceptual design is show in Figure 3. In the proposed structure, there are two kinds of agents, server agent, and client agent. As the name indicates the function of a CA is to read the measured data, filter out the useless information, and then transmitted the useful data to SA. The SA on the other hand receives data from various CAs, distributed on ship, and then it analyzes the data, performs power quality assessment, and then shows the output. Therefore, at any given instant the MAS consist of one SA and several CAs. Proper considerations are needed for the location of these agents. These locations will be decided based on the availability of the measured data and the components for which power quality needs to be monitored (sensitive loads, pulsed power loads and generators)(figure2).[6]

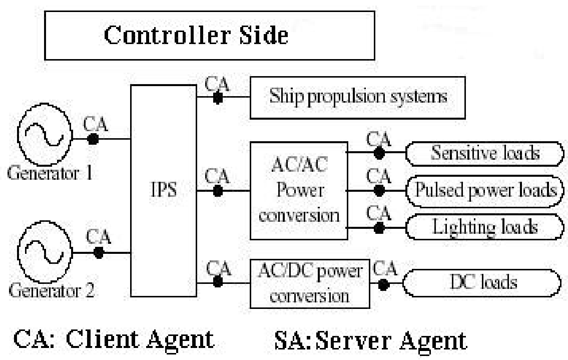


Fig 2. Conceptual design of a MAS-based power quality monitoring system

The CAs and SA must perform some specific functions. The detailed functions of a CA are:

- Data acquisition (voltage and current waveforms)
- Digital signal processing (Fourier analysis, and wavelet transform)
- Power quality index computation (total harmonic distortion, power factor)

The detailed functions of an SA are:

- Harmonic load flow
- Power quality phenomena locator (tracking harmonic sources and sag sources)
- Analyzing the cause of transient process (capacitor switching, thyristor notch)

One of the most significant advantages of Navy all-electric-ship application is to improve the reliability of its power quality monitoring system, especially in the event of damage. Obviously, in that case the whole client-server system cannot work if the server is in the damaged section of ship. Proposed MAS based system will survive by simply reconfiguring the architecture (change a CA to a SA). The process of reconfiguring its own architecture, in the event of damage to the SA, consists of another CA taking charge and becoming SA. In order to decide which CA will become SA a priority list is established. The order of CAs on this priority list is based on their location, and computational facility available to that CA. It is not necessary that all CAs will have this property. This also brings another point that an SA will not only just function as SA but will simultaneously function as a CA. So when a CA becomes SA it does not stop working as CA, instead it gets an overloaded responsibility to perform the functionality of SA. In other words, client agents can be classified into those with the ability of being an SA, and others without the ability. Those CAs with the ability of converting to a SA, also consists of a CA-SA conversion module that takes care of conversion to SA. According to the algorithm of this module if the CA is next in priority list then it will receive a periodic signal from the SA. If something happens to the SA then this periodic signal will be interrupted. In such an event if the CA does not receive any signal from SA for a specific amount of time then it assumes responsibilities of SA. In order to become an SA the CA first sends signals to its neighboring CAs, informing them about its new status. Neighboring CA then propagates this message to its neighboring CA and thus finally all the CAs are informed about the identity of the new SA. Therefore, the CA-SA conversion module performs the functions of receiving and interpreting signals from SA and neighboring CAs. It also performs the function of transmitting appropriate signals to neighboring CAs. [7]

III. A PROTOTYPE FOR GENERAL MEASURES

Intelligence metric in general is difficult to be written in an analytical form. However, an engineering construction approach may be useful. The process of evaluating intelligence itself is an intelligent process. To break this infinite loop, we must start from some systems that are canonically intelligent. Humans are the main option. Some prototype machine systems are first constructed and are approved to be intelligent by humans. These initial systems are not necessarily perfect in terms of natural intelligence. The criteria of intelligence are numerous and the most important one is the capacity of judging the intelligence of other systems. The intelligence evaluation process is not a calibration process where a less precise machine is able to calibrate a more precise one. A more pragmatic approach is needed. The prototypes that have been evaluated by humans now can evaluate other machines, as shown in figure 5. The evaluated systems can be further used to evaluate other systems. It should be noted that this is not a one shot operation and the first round of evaluation is usually inaccurate. In later iterations, every system (including the first prototype) will have the chance to improve its evaluation capability by comparing others' evaluations with its own one. A steady state for the system, if reachable, informs us that it has achieved stable and more accurate evaluations for other systems. The key of this approach is that an intelligent system is able to talk to its neighbors such as evaluations by other systems. [8], [9]

IV. MONITORING POWER QUALITY NETWORK

PQN enables utility and industrial users to view power quality data via a Network browser program. Utilizing these readily available applications, PQN eliminates the engineering effort and costs of developing custom client-side applications

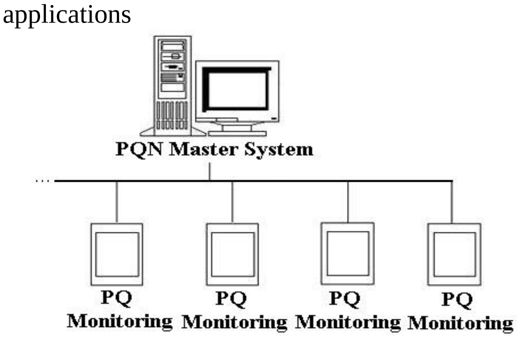


Fig3. Power Quality Monitoring Network

PQN enables users to view downloaded and characterized power quality disturbance data. Designed with password protection for data security, the software can be used for both Internet and company intranet (Network) applications. In Power quality network, data management system is Heart of PQN. PQN stores data retrieved from power quality measurement devices (as ION), into a large database and eliminates the need for repetitive tasks such as data characterization and analysis and report writing. Until PQN arrived on the scene, instrument and event data had to be analyzed using separate applications, requiring an engineer to master each one in order to make a complete analysis. Incorporating technology developed under EPRI sponsorship, PQN not only brings all the information together into one relational database, but it provides the power quality engineer with the means to automate both the loading of new data and the generation of monitoring reports. PQN comes with a base set of reports, which provide information on raw measurements, detailed statistical analysis, and executive summaries. From retrieved data, PQN has the ability to perform statistical studies such as trends, histograms, and correlations. These reports allow the engineer to reach all of the audiences interested in the system monitoring results. [8], [9]

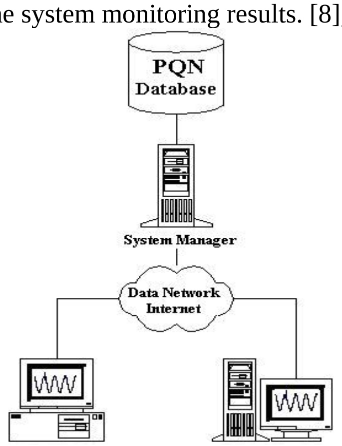


Fig4. Data Acquisition in PQN System

V. INTELLIGENT MONITORING WITH ION

Intelligent measurement and control systems of ION with concern to hard ware structure and easy contact with user can measure and control can measure needed parameters for canceling voltage disturbances process. Such as rms, mean and peak values of voltages. Process of measurement and control system are divided to below sections.

V-1. Data Acquisition:

First stage process is data acquisition from power system. Sampling signals from voltage transformers are applied to ION. Use of these transformers is because of bound of applicable signals peak to ION. If we use this device in low voltage systems, it is not need to use PT.

V-2. Analysis of Data:

Measuring will been analyze with special functions that were programmed in the ION.

N-3. Control and monitoring of System:

With analysis of the input voltages and currents, intelligent control and monitoring system will determine compensating signals for system performance improvement. Sending of these signals are done from the may of ports such as RS 232, RS 485, Modem, 10-Base T, LF to other ION's or computers. PEGASYS or IONEnterprice, provide connection of power system, ION and computer. Really, these software's makes possible connecting of hardware's. We can divide benefits of using this device as below:

Many output ports and ability of using of each in special states.

Possibility of connection to several ION's and computers to improving of control and monitoring performance.

Increasing of speed, resolution and value of process

Intelligent operation of control system in power system parameter changing conditions

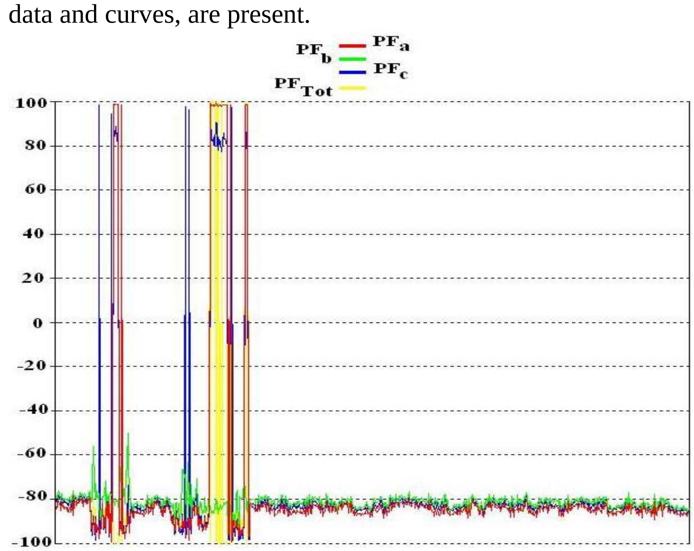
Easy contact with ION and ability of control and monitoring over than via software's

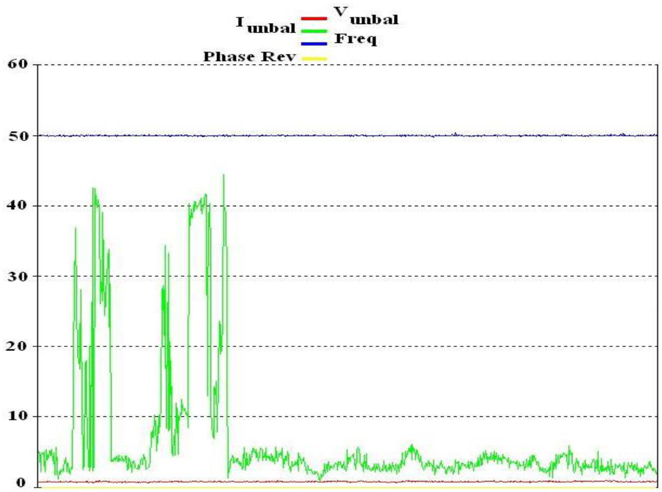
VI. PROTOTYPE OF POWER QUALITY MONITORING WITH ION

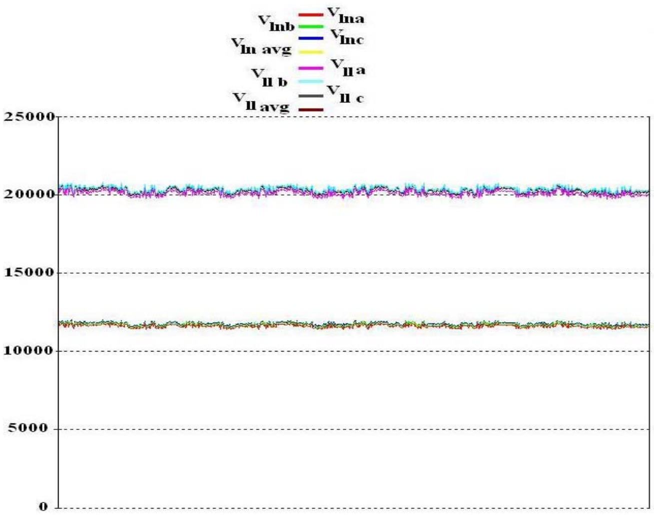
In this part, we report the measuring parameters in a company in Tabriz city. These measuring and monitoring reports made with using an ION 7330. (Six part of Figure5)

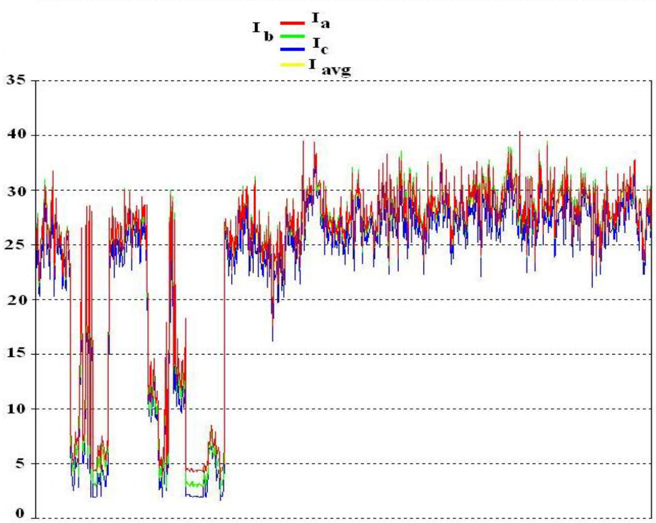
RESULT

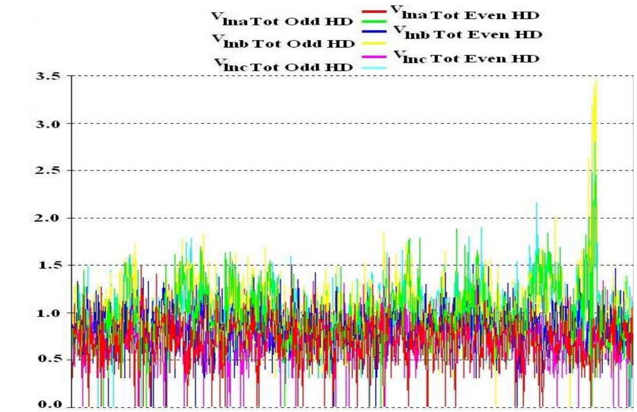
In this paper, in the first introduce Power Quality, then present basis of Intelligent Systems, Agent Technology and shown a Power Quality Monitoring Systems Based On Multi Agent Systems. Intelligent measurement, control, and monitoring systems of ION introduce, at last, result of monitoring of power quality in a company that are actually data and curves, are present.











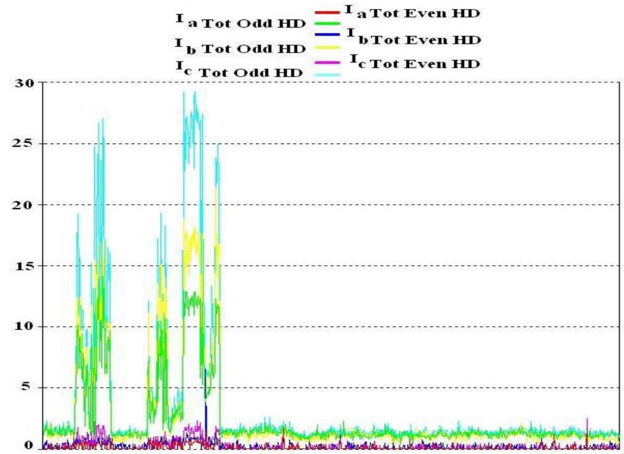


Fig5. Monitoring Result with ION 7330

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