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Detection and Measurement of Power Quality Parameter

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Abstract – *In recent years, power quality problems are increasing to all field because of increasing the number of electric sensitive loads. Poor power quality affecting sensitive loads so causing instability, loss of data and great loss of economy. This paper Detect power quality problem occurring in power system and there is needs to improve power quality. This paper presents a low cost hardware to detect and measure most occurring power quality parameters in the power system such as voltage sags, voltage spikes, voltage swell, harmonic distortion, voltage fluctuation, voltage unbalance, noise etc. UsingPICmicrocontroller16F877A. Microcontroller which senses voltage and detect the problem and gives output through LCD display. This system consists of voltage sensing unit, signal conditioning system, PIC microcontroller 16F877A, LCD display, LED as well as personal computer. LED is used to showing power quality problem and voltage values.*

Key words: Hardware, LCD display, PIC 16F877A, Power quality problems etc.

1. INTRODUCTION

In power system, electricity is generated, transmitted, distributed. Power is mostly alternating current (AC) form. Power is simply the flow of energy. "Power quality" is quality of the voltage rather than power or electric current. Power supply is many problems are created because of variation in the voltage or frequency and distortion in the waveform. Power supply is available in voltage or frequency with a pure sinusoidal waveform. Power quality is a set of properties of electrical boundaries that allow electrical system. Power quality many changes are generated due to the some natural reasons or some fault of the operations. Power quality is changed into the industrial fields because of which include increases and decreases to voltage. Power quality problem technically defines as power disturbances. Power quality problems are generated in the electric system. When any one fault occurring in the electric system. The Reasons for creating fault are lightning strikes, trees falling on the lines, lines short circuit faults, transformers energizing or human error and failure of electrical equipment. This system is simple, secure and low cost. System will be minimizing losses in failure of the equipment and to Increase plant productivity. In Electrical system, generated electricity quality is degraded due to various load condition. Power quality detection is the best way to detection and measurement of power quality problem in electrical power system. The proposed method is simple, convent and less expensive.

2. Problem Associated with power quality

Following is the important power quality problems of power system and its likely effect on sensitive equipment.

2.1 Voltage Dips

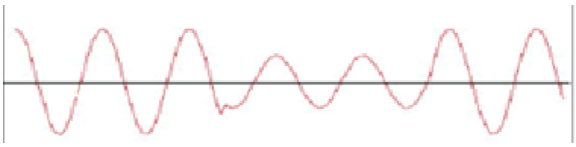


Figure2.1. A Voltage Sag (or dip) Waveform

Short duration under voltages is called "Voltage Sags" or "Voltage Dips". Voltage sags is a decrease of RMS voltage to value between 0.1 and 0.9And lasting for duration between 0.5 cycles to minute. Voltage sags as voltage dips .voltage sags is mainly due to system faults.

2.2 Voltage Spikes

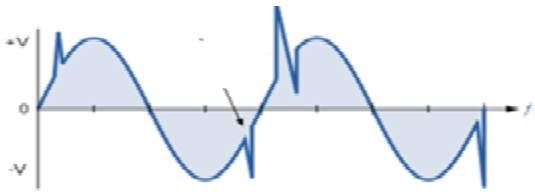


Figure2.2. Voltage Spikes

Voltage spikes occur when there is a sudden voltage peak of up to 6,000 volts.

These spikes are usually the result of nearby lightning strikes, but there can be other causes as well. The effects of voltage spikes on weak electronic systems are loss of data and burned circuit boards.

2 .3 Voltage swell

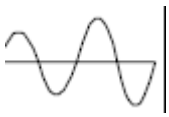
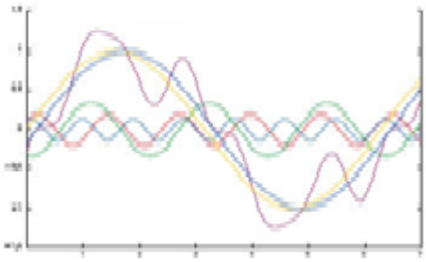


Figure2.3. Voltage swells

Voltage swells defined as Increase in the RMS voltage level to 110% - 180% of nominal, at the power frequency for

durations of 0.5 cycles to 1 minute. The RMS value of the voltage is increases in a half cycle to a few seconds.

2.4 Harmonic Distortion



Electric Waveform With Harmonic Distortion
Figure2.4. Harmonic Distortion

Harmonics levels are increasing from the power systems due to proliferation of power converter circuits which are based on switched mode topologies. Harmonics are as considered steady state events, where the 50 Hz waveform of voltage and /or current becomes distorted. Harmonics are not normally caused by the utility system itself. They are the result of non-linear loads. These loads can inject harmonic currents into the utility system and in severe cases cause problems for surrounding customers.

2.5 Voltage fluctuation

Figure2.5. Voltage fluctuation

Continuous changes in the nominal value of the supply voltage are called voltage fluctuations.

2.6 Noise

Figure2.6. Noise

Superimposing of high frequency signals to the waveform of the power system frequency. It is causes by electromagnetic interferences provoked by hertzian waves such as microwaves, television diffusion and radiation due to welding machines, arc furnaces and electronic equipment

2.7 Voltage Unbalance

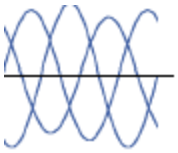


Figure2.7. Voltage Unbalance

Unbalance in a three-phase system is a situation in which either the three-phase voltages are not equal to magnitude or the phase differences between them are not 120° or both.

3. Block diagram:

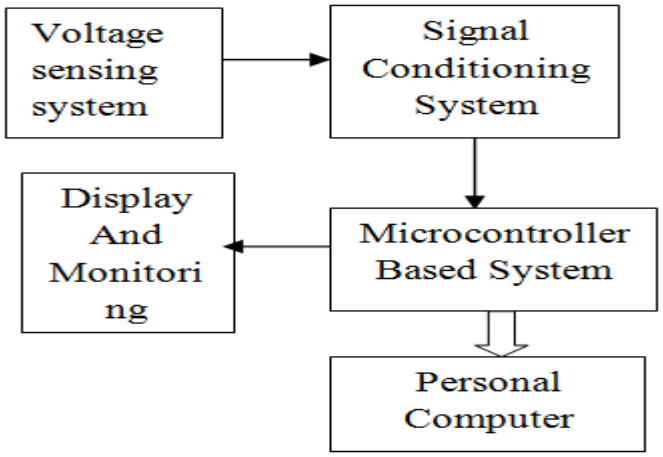


Figure 3.1: Block Diagram for detection of power quality problems.

Block diagram representing various blocks and their interconnection of detection of power quality problems is shown in fig. the main component signal conditioning system includes transformer, wave shaping circuit and voltage divider network. The peak value of input voltage is sensed and processed. The ADC converter the samples of input signal into multiple digital equivalent value. PIC microcontroller is powered from the power supply. This gives constant 5V DC from 230V AC supplied. Microcontroller receives input signals corresponding to voltage values from voltage sensing unit. The microcontroller system is used to store, analyze and process these voltage values. The variation in these voltage values is detected. It is based on these sampled inputs. The program written in microcontroller. It checks the voltage signal and gives signal to output devices: liquid crystal display (LCD), Light Emitting diodes (LEDs). LCD Display indicates the type of power quality problem created along with voltage values. The faulty conditions of problems like voltage sag, voltage swells, voltage surges or spikes, under voltage, distortion, voltage fluctuations and unbalance are indicated by the respective LEDs and LCD display message. The serial port interface with computer used for further storage and analyses of data.

4. Schematic Circuit Diagram:

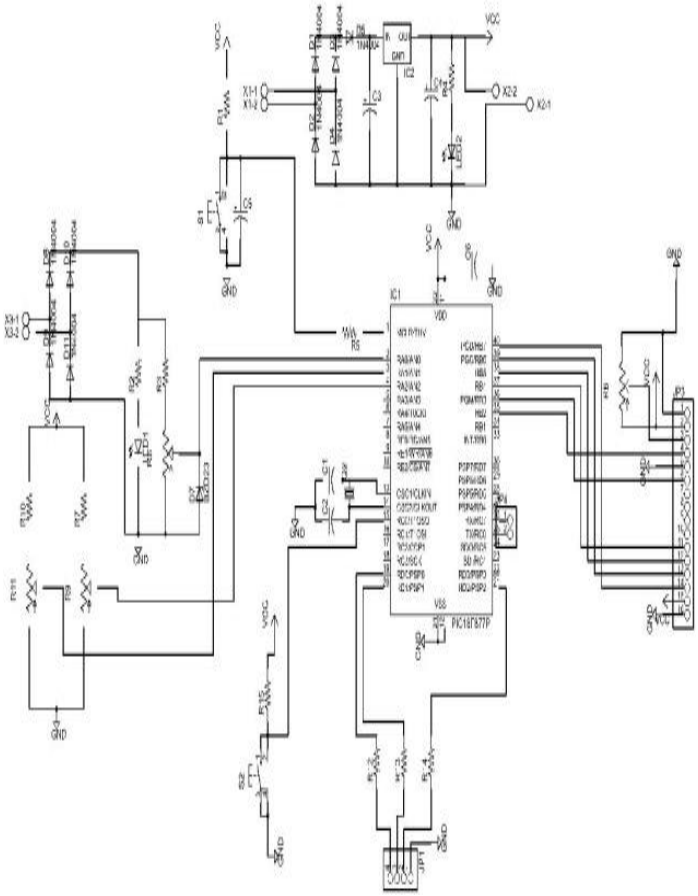


Figure4.1. Schematic Circuit Diagram of proposed system

Voltage sensing unit: The voltage sensing unit senses AC voltages and converts them into the required from.

Signal Conditioning System: Signal conditioning system consists of transformer, rectifier and voltage regulator etc. In this system transformer is used For transferring the electric power from one circuit of another circuit of change in voltage and current but not change in frequency. This system use the step-down transformer because of it converts high voltage at the primary side to low voltage at the secondary side.230V,1-phase AC supply is given to step down transformer. In step-down transformer 12V AC they take at primary side. Transformer 12V AC supplies input gives to the rectifier. This system use half waves rectifier to convert AC to DC .the input provided here is an alternating current. This input voltage is stepped down using a transformer.

$$Vdc = Vmax/\pi$$

$$= 0.318Vmax$$

$$= 0.45Vs$$

Voltage divider is used for adjusting the level of signal for bias of active devices in amplifiers and for measurement of voltage.

$$Vout = \{R2\backslash(R1+R2)\}Vin$$

If R1=R2 then,

$$Vout=1\backslash 2\ Vin$$

This system use zener diode & It is a type of diode and current flow from anode to cathode but also in reverse direction. zener diode have highly doped P-N Junction. Voltage signal is obtained from voltage sensing units are given to analog to digital converter. Analog protection circuit is connected to controller.

Power supply system: The power supply uses DC Power and it operated from in source of AC power such as 120V, 50HZ line. A DC Power operated in an AC source. The DC supply is passed through a filter. This removes ripples in unidirectional supply of the rectifier. This system uses 7805 ICs. It is fixed voltage regulator ICs. The filtered DC supply is given to 7805 regulators to regulate the voltage at 5V and is given to power the PIC Microcontroller.

Microcontroller system: Proposed system PIC microcontroller is used to synthesize sinusoidal signal. It is powerful microcontroller. In proposed system high frequency sine wave synthesis is possible due to the PIC 16F877A can work with high frequency oscillator.

Feature:

Single–supply 5V in circuit serial programming.
Wide operating voltage range (2Vto5.5V)

operating speed: DC20Mhz clock input ,DC 200NS instruction microcontroller system sampling analog input and detect the which power quality problem is created such as voltage sag, voltage swells, voltage surges or spikes, under voltage, distortion, voltage fluctuations etc.

Display and Monitoring System: In this system 16×2 LCD is used to display normal and abnormal condition along with voltage values in p.u. LCD is electronic visual display. The LCD is connected to microcontroller. LCD receives signal from microcontroller and displays voltage sag, voltage swells, voltage surges or spikes, under voltage, distortion, voltage fluctuations conditions respectively. This circuit is used to calculate and display the result of power quality parameter.

Personal computer: In proposed system voltage information is sent to ADC of microcontroller after these values are sending to PC through USART communication. USART is serial communication interface and it used for calculation of power quality parameter voltage sag, voltage swells, voltage surges or spikes, under voltage, distortion, voltage fluctuations etc .the calculation are done in MATLAB software. The graphical user interface is provided with MATLAB in display and monitoring system.

5. Flow chart for detection of power quality parameters:

A. Flow Chart of Sampling Process

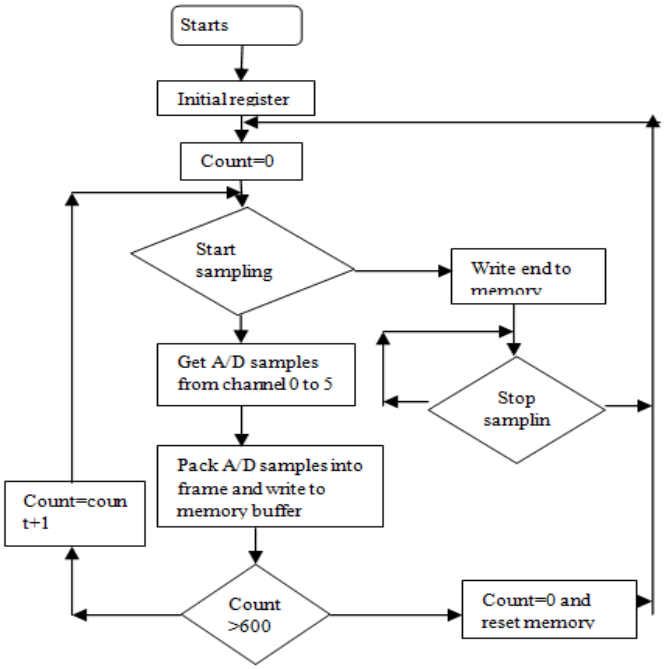


Figure5.1. Flow chart of sampling process

B. Flow Chart

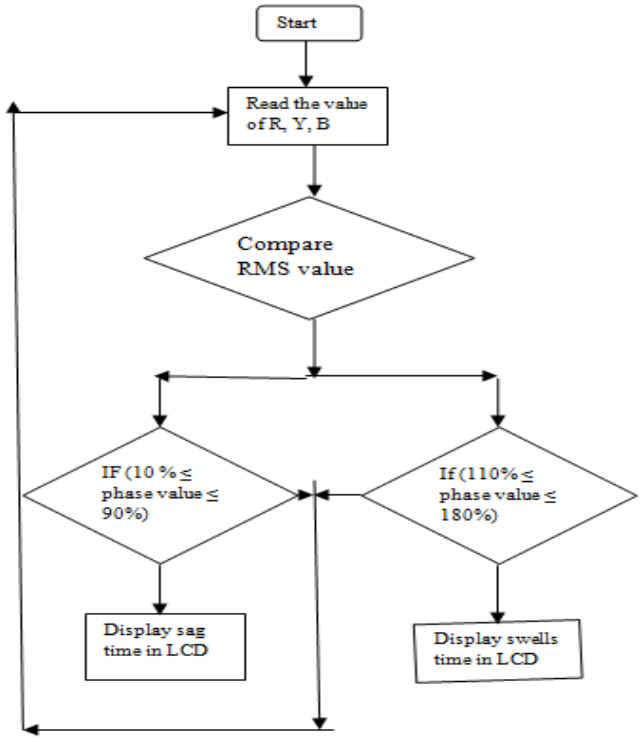


Figure 5.2. flow chart

In system program for microcontroller is coded in embedded C language using PIC compiled software. Program is compiled then it is converted into hex code. The hex code is loaded in ROM into microcontroller by using proteus software.

6. Result and Discussion

The following table 1 and 2 shows the power quality definitions IEEE categories STD 1159-1995

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Table1: Power quality definitions IEEE categories STD 1159-1995 sag

SAG	DURATION
Instantaneous sag	0.5-30 cycles
Momentary sag	30-3 second
Temporary sag	3sec-1min

Table2: Power quality definitions IEEE categories STD 1159-1995 swell

Swell	Duration
Instantaneous swell	0.5-30 cycles
Momentary swell	30-3 second
Temporary swell	3sec-1min

Table3. Output of Hardware Testing

Condition & microcontroller input voltage	LCD output	Sag Indicator	Swell Indicator	INTERRUPTION Indicator
Normal condition 2.7V at input	NC 1.00	OFF	OFF	OFF
Sag 1.6V at input	SAG 0.60	ON	OFF	OFF
Swell 3.9V at input	SWELL 1.42	OFF	ON	OFF
Interruption 0.06V at input	INTERRUPTION 0.02	OFF	OFF	ON

7. CONCLUSIONS

The hardware for detection and measurement of power quality parameters in power system is constructed and tested. the system hardware correctly detected normal condition like a voltage sags , voltage swells, voltage surges or spikes, under voltage, distortion, voltage fluctuations etc. when normal condition occurs to the system LCD indicates the condition and voltages. During to sag, swell and interruption, LCD indicates the type of power quality problems and the magnitude of voltage. Hardware of system

is simple, secure and low cost. System will be minimizing losses in failure of the equipment and to increase plant productivity. The proposed method is simple, convenient and less expensive.

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