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Power Quality Improvement by using Three Phase Adaptive Filter Control in Micro Grid

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Abstract - *In this paper we have designed an adaptive filter which is reducing THD levels in micro grid current and voltages within the specified limit. A micro grid system containing a combination of solar PV and Diesel generator is considered here voltage source converter act as a common point in between the solar PV and diesel generation system.*

Key Words: Power quality, micro grid, adaptive filter

1. INTRODUCTION

The idea of power quality is characterized as the ability of the electricity to give costumers solid, perfect and non-tolerant power. In subtleties control quality issues can be ordered into a few levels. At first, it was simply alluding to the accessibility of electrical power, voltage and recurrence guideline inside a particular range. As electrical gadgets are getting progressively delicate, costumers are ending up progressively mindful, and power quality contamination are expanding in the framework, power quality is increasing expanding consideration and it needs to incorporate some different perspectives like harmonic distortion, short time transients, unbalances, interruptions and flickers in addition to initial requirements .IEC 61000, En 50160, IEEE 519 are some IEEE and IEC standards about power quality. standards don't give organized and far reaching talks on power quality in contrast with IEC measures, however IEEE and IEC both have models for this extraordinary point, and it is a proof to the significance of power quality issues in current power frameworks. Power electronic gadgets as a piece of the present network may have some unfortunate consequences for grid parameters, control quality, and framework unwavering quality. These gadgets that are usually utilized in present day systems directly affect on the distribution systems. A case of these toxins is inverter-based DGs, which use control electronic gadgets as an interface to associate with the grid. The significant point is the expanding development of DG execution both by people and electrical utilities. Many researchers have proposed power quality controllers for micro-grids. Least mean square (LMS) is an old technique of removing noise and distortions from the signal [7]. Based on LMS, algorithms such as hyperbolic tangent function based LMS [10], modified variable step filtered-x LMS (FXLMS) based control, etc. have been presented for achieving load leveling, voltage and frequency control and power quality enhancement. LMF is a higher order filter as compared to LMS, and thus, it has a higher signal to noise ratio (SNR) [6]. The superiority of this control over conventional LMS algorithms, in terms of mean square error (MSE) and stability, has been presented in [6] and [8]This paper consists an adaptive filter, in a three-phase DG-PV based isolated micro-grid. It removes the harmonics present in the current due to the nonlinear loads, and makes it smooth sinusoidal, and reducing the total harmonic distortion (THD) as per IEEE-519 standard. This paper includes an adaptive filter. It removes the harmonics present in the current due to the nonlinear loads, and makes it smooth sinusoidal reducing the total harmonic distortion (THD) according to IEEE-519 standard. A boost converter interfaces PV and DC-link of VSC, and performs the maximum power point tracking (MPPT) for PV array.

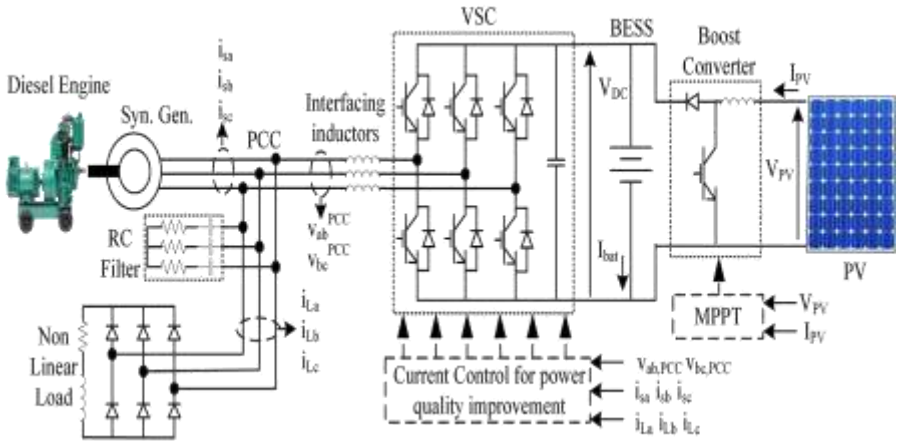

Fig -1: System model

2. PROPOSED SYSTEM

Burning fossil fuels for producing electricity has been a major cause of global warming. Thus, researchers have been looking for alternative sources for electricity production, which are sustainable and environment friendly. Moreover, countries are working towards making their whole automobile fleet and electricity

Production sectors free of burning fossil fuels. This has led to rise in renewable based energy systems such as PV, wind, hydro, biomass, ocean thermal energy, tidal energy, etc. The term Electric Power Quality extensively alludes to keeping up a close sinusoidal power distribution bus voltage at rated magnitude and frequency. In addition, the energy supplied to a customer must be interrupted from the reliability point of view. The major power quality problems which affect the utility grid are presence of harmonic content, load. Many researchers have proposed power quality controllers for micro-grids. Least mean square (LMS) is an old technique of removing noise and distortions from the signal [7]. Based on LMS, algorithms such as hyperbolic tangent function based LMS [10], modified variable step filtered-x LMS (FXLMS) based control, etc. have been presented for achieving load leveling, voltage and frequency control and power quality enhancement. LMF is a higher order filter as compared to LMS, and thus, it has a higher signal to noise ratio (SNR) [6]. The superiority of this control over conventional LMS algorithms, in terms of mean square error (MSE) and stability, has been presented in [6] and [8]This paper consists an adaptive filter, in a three-phase DG-PV based isolated micro-grid. It removes the harmonics present in the current due to the nonlinear loads, and makes it smooth sinusoidal, and reducing the total harmonic distortion (THD) as per IEEE-519 standard.

3. ADAPTIVE FILTERING SCHEME AND IMPLEMENTATION

An adaptive filter is a framework with a linear filter that has an exchange capacity constrained by factor parameters and a way to change those parameters as per an optimization algorithm. As a result of the unpredictability of the optimization algorithm, practically all adaptive filters are computerized channels. Adaptive filters are required for certain applications since certain parameters of the desired processing operation(for example, the areas of reflective surfaces in a reverberant space) are not known ahead of time or are evolving. The closed loop adaptive filter utilizes feedback as an error signal to refine its transfer function.

Most adaptive filtering use adaptive system identification as a methods for tackling another signal processing problem. In this sense, adaptive system identification gives the premise to a wide scope of adaptive signalling processing applications. It is, in this way, fundamental that we have a decent comprehension of the basic standards and presumptions identifying with adaptive system identification.

As portrayed in Figure 2 in adaptive system identification, the goal is to appraise an obscure framework from its input and output observation given by x(k) and d(k), individually. There are limitations for consideration regarding discrete-time signal and systems, so the independent time index k is a number. A model for the adaptive filter is picked dependent on earlier learning of the unknown system qualities with complexity considerations. In its least difficult and most favored structure, the adaptive filter is a finite impulse response (FIR) channel of length N with flexible impulse response coefficients (adaptive filter coefficients):

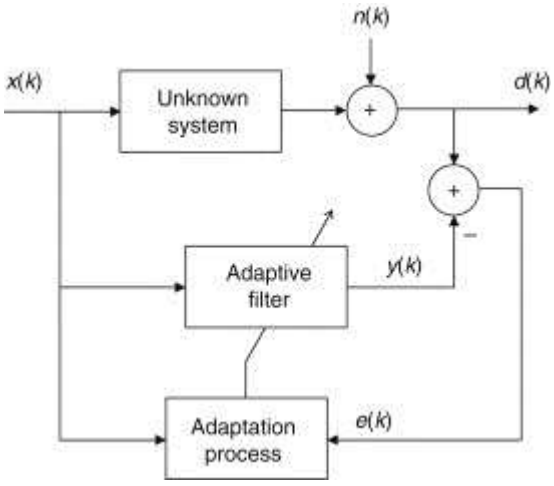

Fig -2: Identification of adaptive system

4. RESULTS

Fig.4.c) shows voltage in KV during fault condition. There is sudden drop in voltage(voltage sag) due to fault. Fig.4.d)shows THD level of fault voltage which is equal to 34.91%,far greater than the standard value of THD according to IEEE standard i.e. 5%.

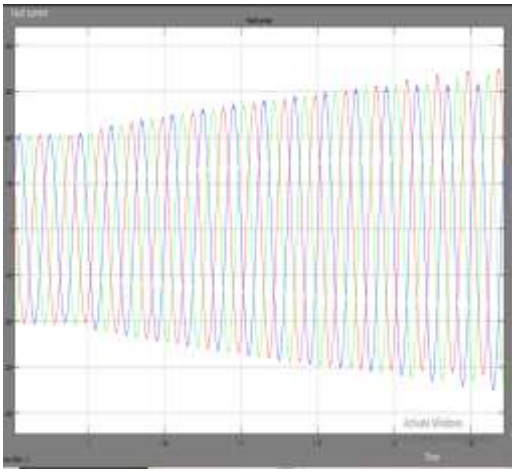

Fig.4.a) Fault current

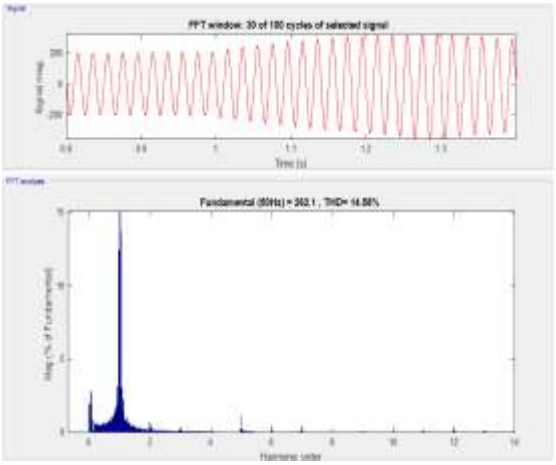

Fig.4.b)THD level of fault current

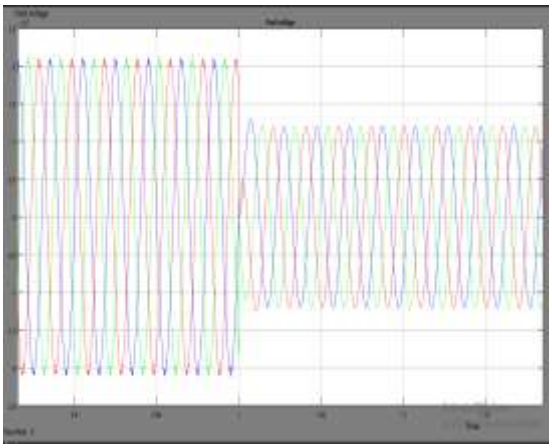

Fig.4.c) Fault voltage

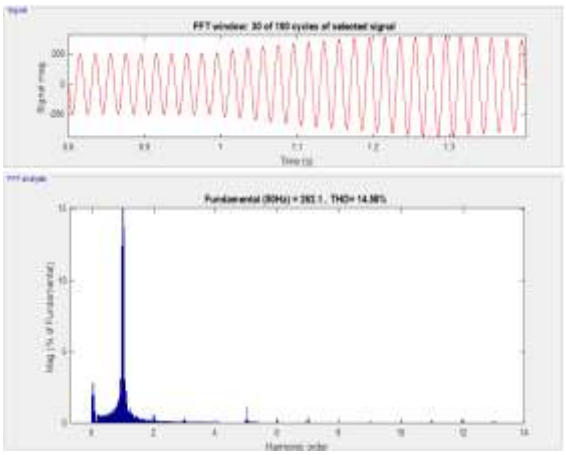

Fig.4d)THD level of fault voltage

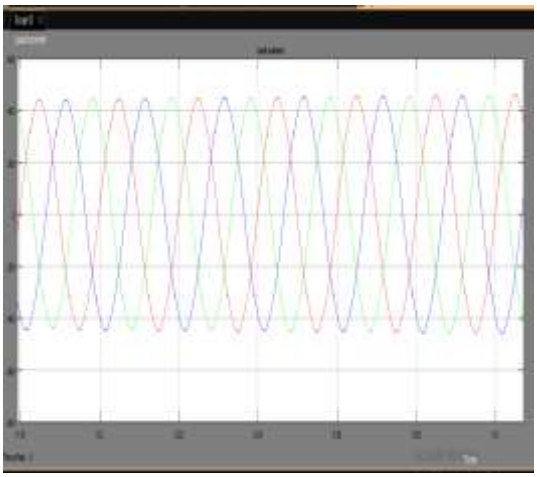

Fig.4.e) Recovered load current

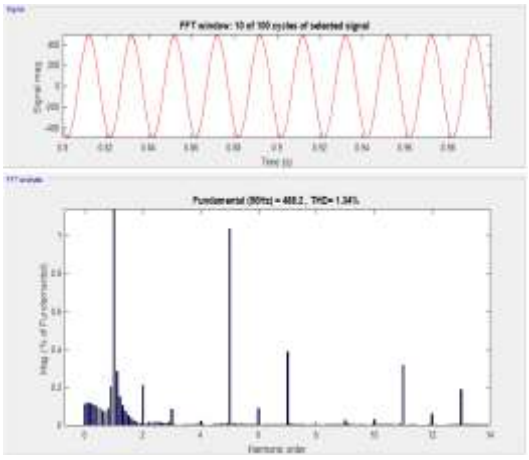

Fig.4.f)THD level of recovered load current

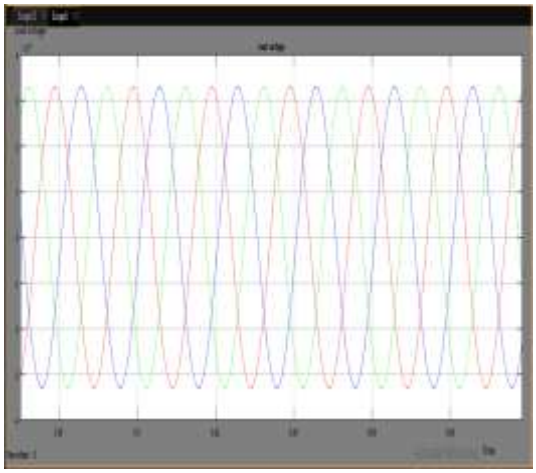

Fig.4.g) Recovered load voltage

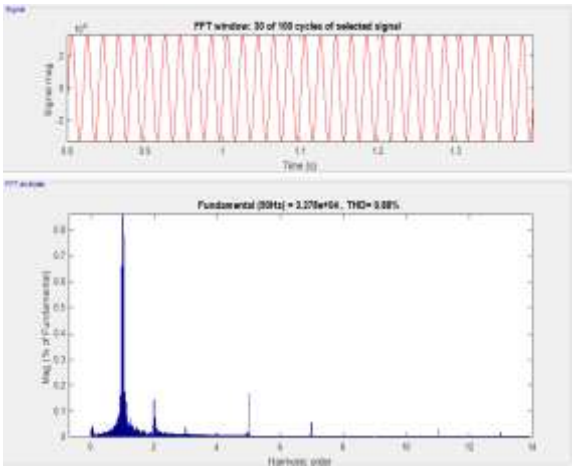

Fig.4.h)THD level of recovered load voltage

Fig4.c) shows waveforms of load voltage when fault occurs. It can be clearly understand that due to fault there is sudden voltage sag which making the THD 34.91%

Fig4.a)shows waveforms of load current when fault occurs .There is increase in current due to fault which again increases the THD level to 7.89%.

Thus due to 3 phase fault the overall THD level increases from standard value according to IEEE standard. But the use of adaptive filtering technique reduces the THD level upto 0.88% as shown in fig.4.h)4 and make the waveform smooth sinusoidal.

Now to recover the load voltage and current to normal levels and to reduce the total harmonic distortion levels to standard value, adaptive filtering technique is used.

The adaptive control for regulating power quality at PCC through VSC is shown in Fig. 1. It calculates the weight of the active and reactive parts of currents and estimates the reference current for each phase, using the in-phase and quadrature unit templates of voltage.

Table -1: THD values of load current and load voltage.

Parameter	THD value
Recovered load voltage	0.88%
Recovered load current	1.34%
Load current when fault occurs	14.58%
Load voltage when fault occurs	34.91%

5. CONCLUSION

This paper has a three phase adaptive filter which reduces the Total harmonic distortion (THD) levels of load current and voltage within permissible level as recommended by IEEE standard. It consists of combination of solar PV system with Diesel generation system which are coupled through a voltage source converter.

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