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Improved THD Profile using Hybrid Shunt Power Filter with Fuzzy controller

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Abstcact - To deliver power to the load side, the harmonics present in the system must be reduced because they have a significant negative impact on the system's power quality and dependability. A passive filter was previously used to lessen the effects of harmonics and increase the overall reliability of the system. The conservative power theory explained why harmonics were present and how they came to be there. However, it is clear from the analysis of the earlier results that the system can still use some improvement. This work suggested a hybrid shunt active power filter for achieving this goal, along with fuzzy set theory to reduce harmonics and enhance the system's power quality. Keywords: Active filters, passive filters, fuzzy logic, multilevel converter.

I. INTRODUCTION

Now a day's power electronic based equipment is used in industrial and domestic purpose. These equipments have significant impacts on the quality of supplied voltage and have increased the harmonic current pollution of distribution systems. They have many negative effects on power system equipment and customer, such as additional losses in overhead and underground cables, transformers and rotating electric machines, problem in the operation of the protection systems, over voltage and shunt capacitor, error of measuring instruments, and malfunction of low efficiency of customer sensitive loads.

Passive filter have been used traditionally for mitigating the distortion due to harmonic current in industrial power systems. But they have many drawbacks such as resonance problem, dependency of their performance on the system impedance, absorption of harmonic current of nonlinear load, which could lead to further harmonic propagation through the power system [2].

To overcome of such problem active power filters is introduced. It has no such drawbacks like passive filter. They inject harmonic voltage or current with appropriate magnitudes and phase angle into the system and cancel harmonics of nonlinear loads. But it has also some drawbacks like high initial cost and high power losses due to which it limits their wide application, especially with high power rating system. [3].

The rising interest in the use of electronic devices levies nonlinear loads to the source that draw active current, reactive current and harmonic current. Due to the reactive current and harmonic current electromagnetic interference with nearby equipment and heating of transformers occur. Power system can sop up harmonic currents with no problem. Resonant condition mainly affects the power problem. In fig.1.1 the source refers to the three phase source (generator) in power system and impedance represents the line impedance. Due to the nonlinear load the current becomes non sinusoidal. As a result we are getting a distorted voltage across the load..

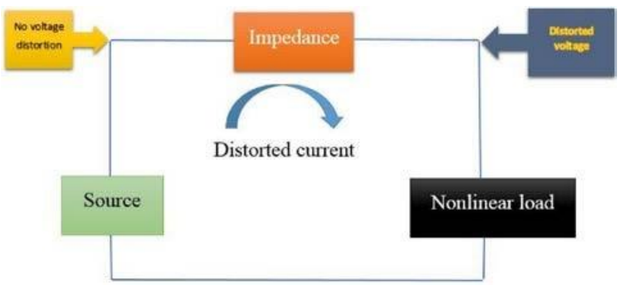

Figure 1.1 Flowchart of generation of harmonic voltage.

Fig. 1.2 shows an active power filter connected in parallel with the main path invalidates all the harmonic current and reactive current from nonlinear loads. As the active power filter provide a fraction of total power for compensation of harmonic and reactive currents it can have low rating which is economical. Among the various control strategies of active power filters pulse width modulation scheme is an efficient one. A hybrid power filter which is a combination of passive filter and active filter improves the resonance characteristics and reduces filter rating.

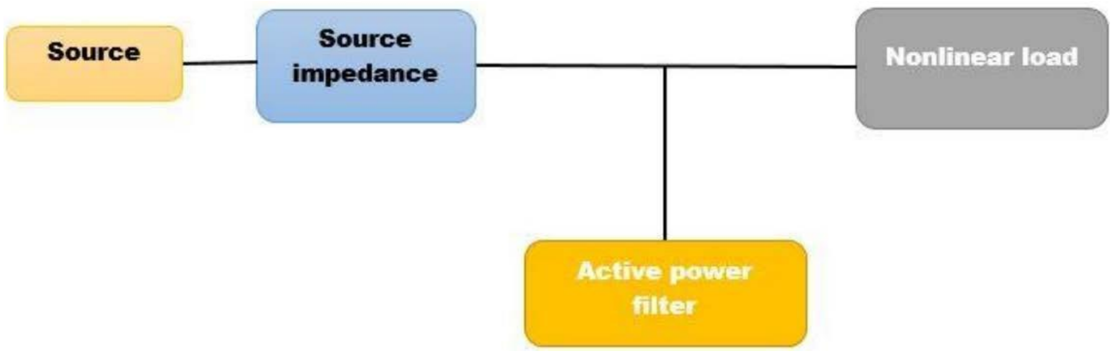

Figure 1.2 Schematics of a system with the shunt active power filter.

II. PROPOSED METHEDOLOGY

The proposed work is based on the active passive hybrid power filter topology and fuzzy logic control as demonstrated in figure. Hybrid filters are based on the combination of active filters and passive filters. Such a combination with the passive filter makes it possible to significantly reduce the rating of the active filter. The task of the active filter is not to compensate for harmonic currents produced by the thyristor rectifier, but to achieve "harmonic isolation" between the supply and the load As a result, no harmonic resonance occurs, and no harmonic current flows in the supply.

And for the harmonic reduction and elimination fuzzy logic controller is utilized. In a fuzzy logic controller, the control action is determined from the evaluation of a set of simple linguistic rules. The development of the rules requires a thorough understanding of the process to be controlled, but it does not require a mathematical model of the system. The internal structure of the fuzzy controller is shown in Fig 2.1

A fuzzy inference system (or fuzzy system) basically consists of a formulation of the mapping from a given input set to an output set using fuzzy logic. This mapping process provides the basis from which the inference or conclusion can be made. A fuzzy inference process consists of the following steps:

Step 1: Fuzzification of input variables

Step 2: Application of fuzzy operator (AND,OR,NOT) in the IF(antecedent) part of the rule

Step 3: Implication from the antecedent to the consequent (THEN part of the rules)

Step 4: Aggregation of the consequents across the rules

Step 5: Defuzzification.

The crisp inputs are converted to linguistic variables in fuzzification based on membership function (MF). An MF

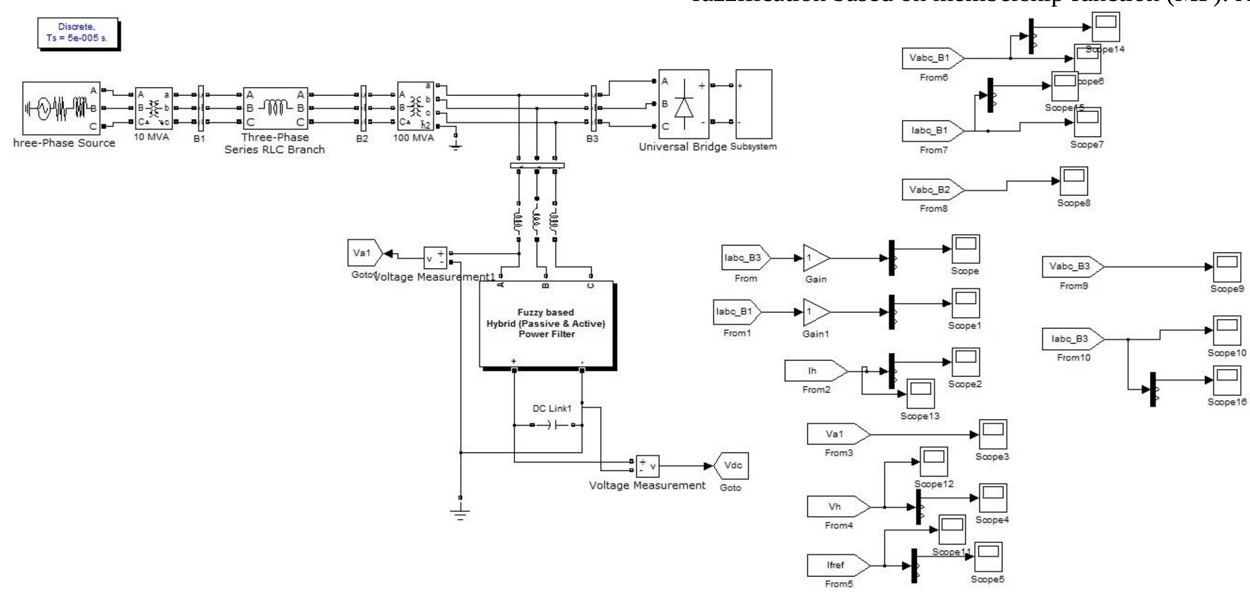

Figure 2.1 Proposed simplified model with Hybrid (active & passive power filter) and Fuzzy Controller.

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is a curve that defines how the values of a fuzzy variable in a certain domain are mapped to a membership value μ (or degree of membership) between 0 and 1.

Figure 2.2 Demonstrated controlling of system using fuzzy logic controller

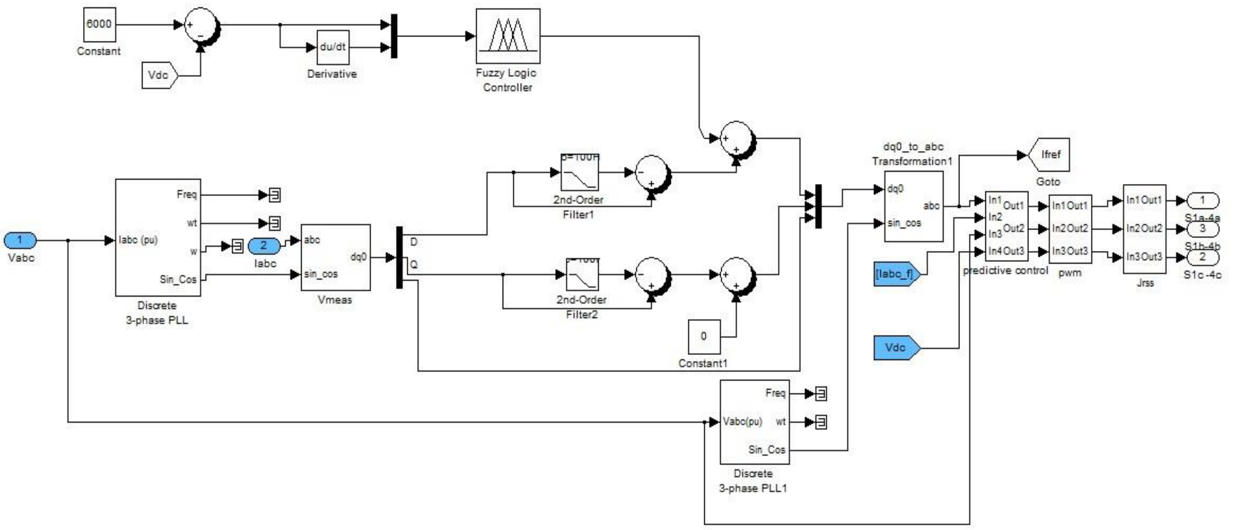

Figure 2.2 Fuzzy Logic Controlling in Proposed System

III. SIMULATION RESULTS

Proposed system has been implemented and Simulated on Matlab/Simulink Platform the output results of proposed work has been given in the following Figures.

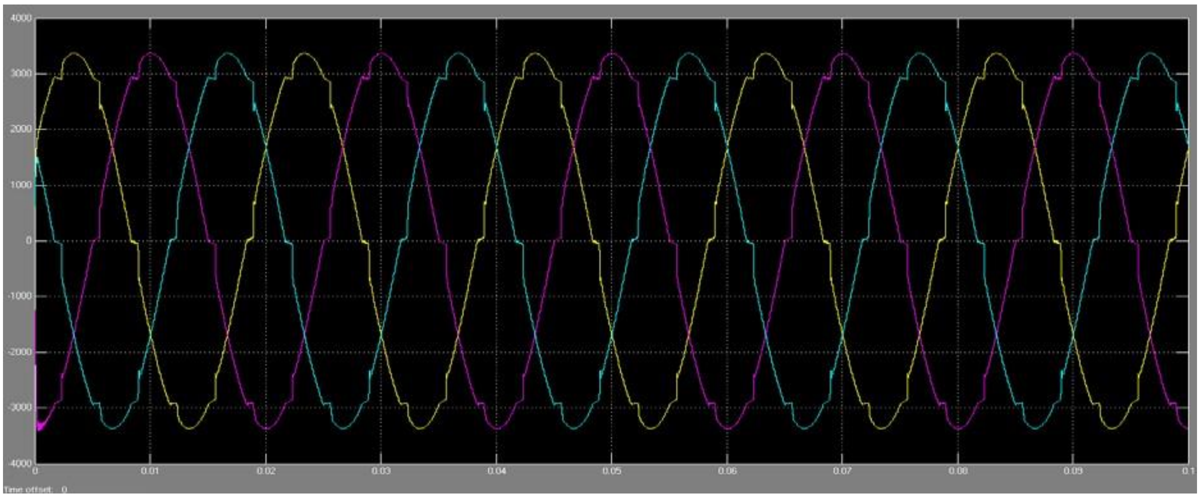

Figure 3.1 Extension 3 phase currents & single phase currents

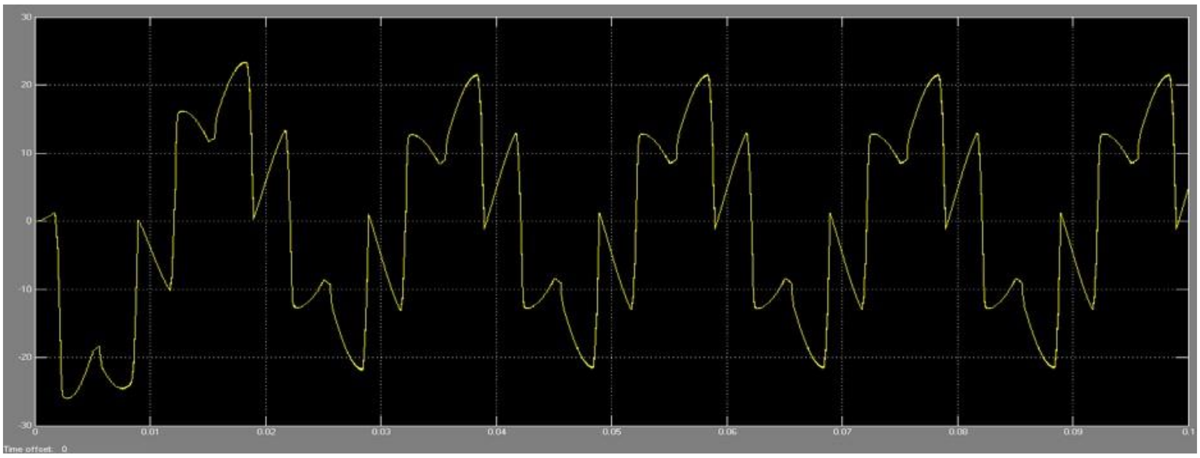

Figure 3.2 Extension PCC voltages.

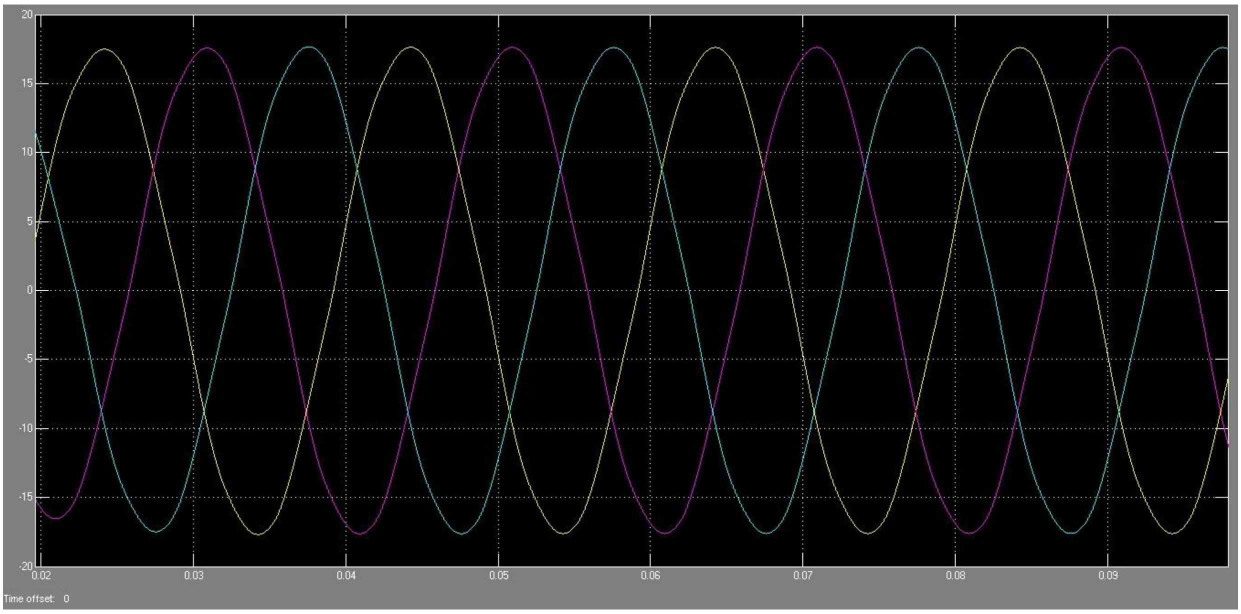

Figure 3.3 PCC2 Three Phase Current

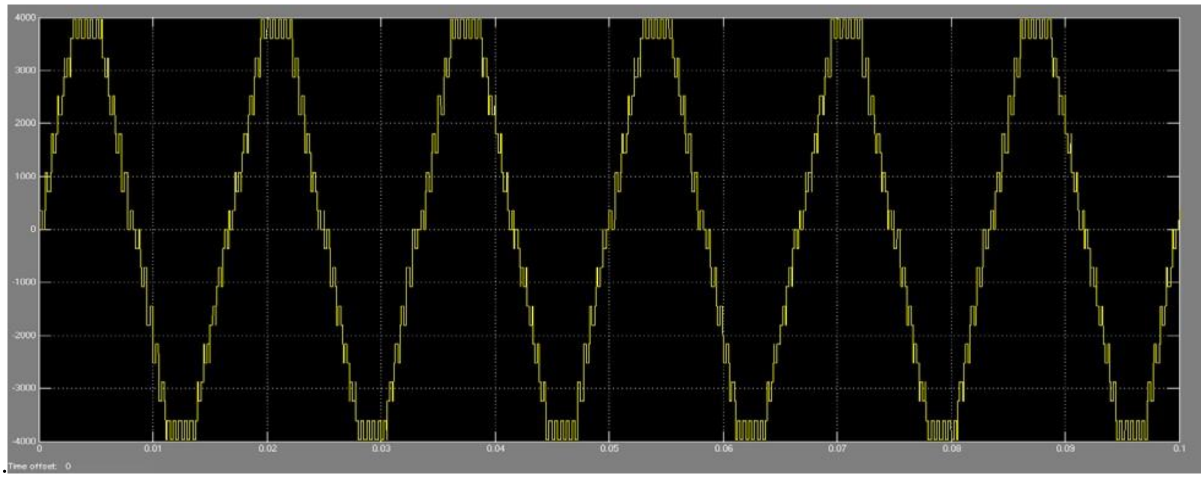

Figure 3.4 Extensions multilevel output waveform.

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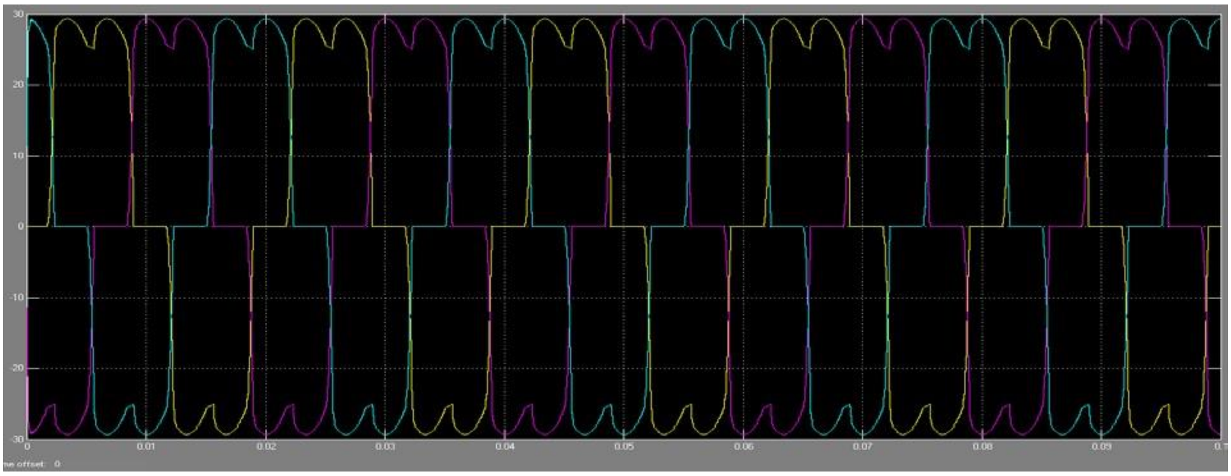

Figure 3.5 ECC current waveform.

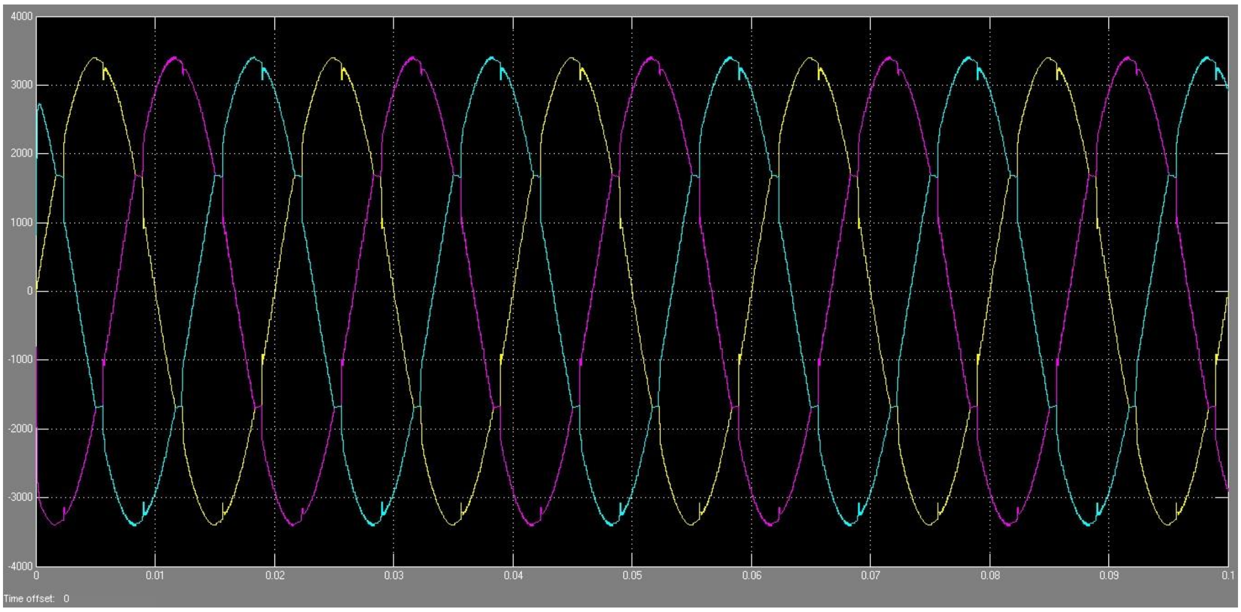

Figure 3.6 extensions PCC current

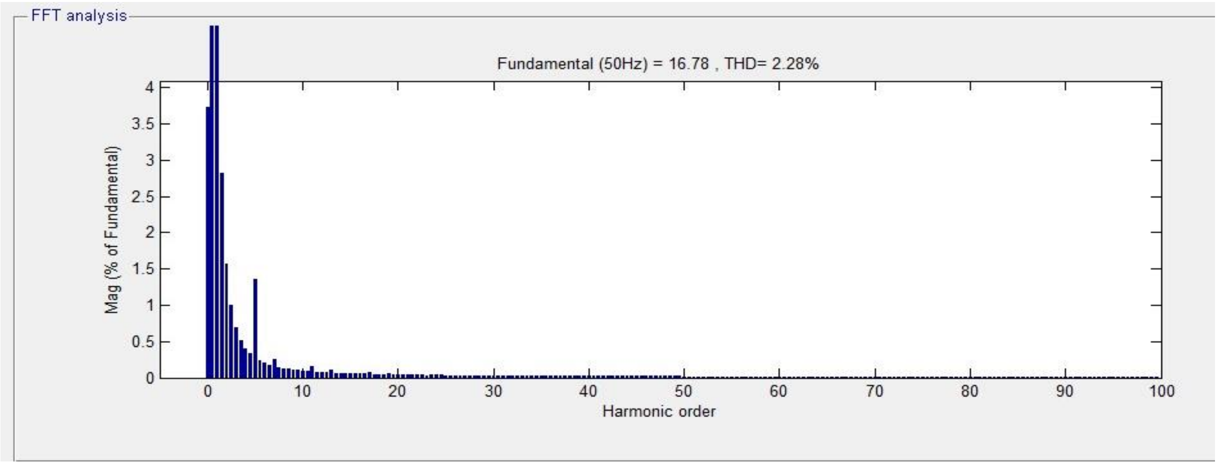

Figure 3.7 Extensions THD 2.28 %

IV. CONCLUSION

Power quality enhancement using a shunt active power filter has been researched. The performance of the system is examined using a variety of simulations. For the non-linear load's harmonic and reactive power compensation, hybrid power filters based on both PI controllers and fuzzy logic controllers are used. For use in MATLAB, a program has been created to simulate fuzzy logic-based and hybrid power filters. Through the reduction of harmonics and reactive current in the load current, which results in a sinusoidal load current that is in phase with the source voltage, shunt active power filters are found to improve the power quality of the power system. It has been examined and compared how well both controllers perform.

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