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FUZZY LOGIC BASED ENERGY CONVERTER FOR STATCOM TO IMPROVE POWER QUALITY

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Abstract : This paper deals with controlling the line loss that occurs in long transmission line by controlling the voltage sag. Commonly the voltage sag occurs in long transmission line which result in power quality issue. Here the prototype model of this explains about it. We are improving the output power by boosting the output power using feedback .This process consist of ac to dc converter, fuzzy logic controller, filter, transformer, sensing unit, resistor and power supply. The result of this is attached in the paper.

IndexTerms **- Fuzzy logic controller, converters, power supply, sensors, filters.**

INTRODUCTION

Power Quality (PQ) related issues are of most concern nowadays. Electrical Power quality is the degree of any deviation from the nominal values of the voltage magnitude and frequency. From the customer perspective, a power quality problem is defined as any power problem manifested in voltage, current, or frequency deviations that result in power failure or disoperation of customer of equipment. The waveform of electric power at generation stage is purely sinusoidal and free from any distortion. Many of the Power conversion and consumption equipment are also designed to function under pure sinusoidal voltage waveforms. However, there are many devices that distort the waveform. These distortions may propagate all over the electrical network. The widespread use of electronic equipment, such as information technology equipment, power electronics such as adjustable speed drives (ASD), programmable logic controllers (PLC), energy-efficient lighting, led to a complete change of electric loads nature.

These loads are simultaneously the major causers and the major victims of power quality problems. Mainly there are different power quality problems. Voltage sag, voltage swell, harmonics, very short interruptions, long interruptions, voltage spike, noise, voltage unbalance these are the main PQ problems in power system. A wide diversity of solutions to power quality problems is available for both the distribution network operator and end user. The measure of power quality depends upon the needs of the equipment that is being supplied. Custom Power devices are a better solution for these Power Quality related issues in distribution system. Out of these available power quality enhancement devices, the STACOM has better sag/swell compensation capability.

According to the basic idea of STACOM, it consists of back-to-back connection of two three-phase active filters (AFs) with a common dc link. The point of common coupling (PCC) could be highly distorted, also the switching ON/OFF of high rated load connected to PCC may result into voltage sags or swells on the PCC has been discussed.

There are several sensitive loads, such as computer or microprocessor based AC/DC drive controller, with good voltage profile requirement; can function improperly or sometime can lose valuable data or in certain cases get damaged due to these voltage sag and swell conditions. One of the effective approaches is to use a unified power quality conditioner (STACOM) at PCC to protect the sensitive loads. The concept of FLC is to utilize the qualitative knowledge of a system to design a practical controller.

For a process control system, a fuzzy control algorithm embeds the intuition and experience of an operator, designer and researcher. The control doesn't need accurate mathematical model of a plant, and therefore, it suits well to a process where the model is unknown or ill-defined and particularly to systems with uncertain or complex dynamics. In this paper the application of fuzzy logic in control of shunt and series active power filters for control of three-phase active power filter.

PROPOSED SYSTEM

This chapter presents a novel control strategy for the case of three phase four wire unified power-quality conditioner (STACOM) based on the concepts of fuzzy hysteresis band voltage and current control. Using fuzzy hysteresis band voltage and current control, voltage sags and swells, and along with current and voltage harmonics compensation, reactive power compensation has been simulated and the results are analyzed.

In this project we are using fuzzy logic controller to senses the feedback and to promote the output power which helps in reducing voltage sag and power quality issue.

The fuzzy logic controller connected with filter to purify the output and sensing unit senses the quality of output power.

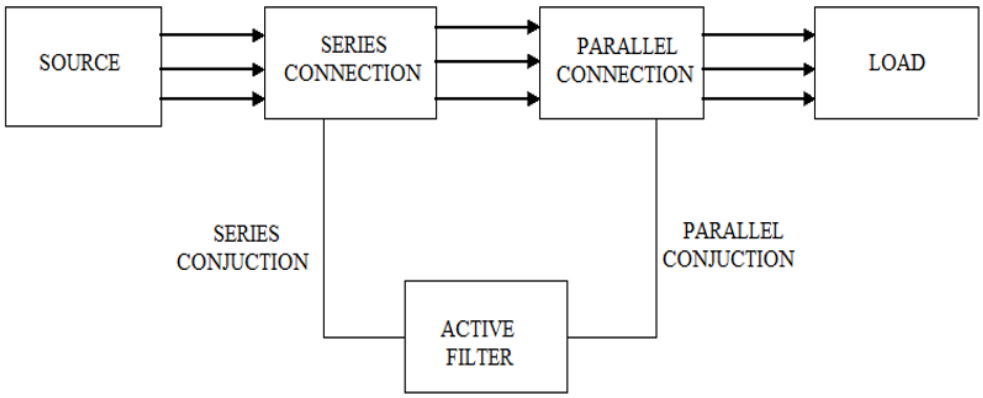

Fig 1 BLOCK DIAGRAM OF PROPOSED SYSTEM

FUZZY LOGIC ALOGRITHM

The fuzzy control algorithm consists of a set of fuzzy control rules which reflects the experience gained from the plant operation. The rules are combined by using the implication and the compositional inference. The FLC comprises of three parts: fuzzification, interference engine and defuzzification. The FLC is characterized as

- Seven fuzzy sets for each input and output.
- Triangular membership functions for simplicity.
- Fuzzification using continuous universe of discourse.
- Implication using madman's 'min' operator.
- Defuzzification using the 'height' method. The knowledge bases are designed in order to obtain a good dynamic response under uncertainty in process parameters and external disturbances.

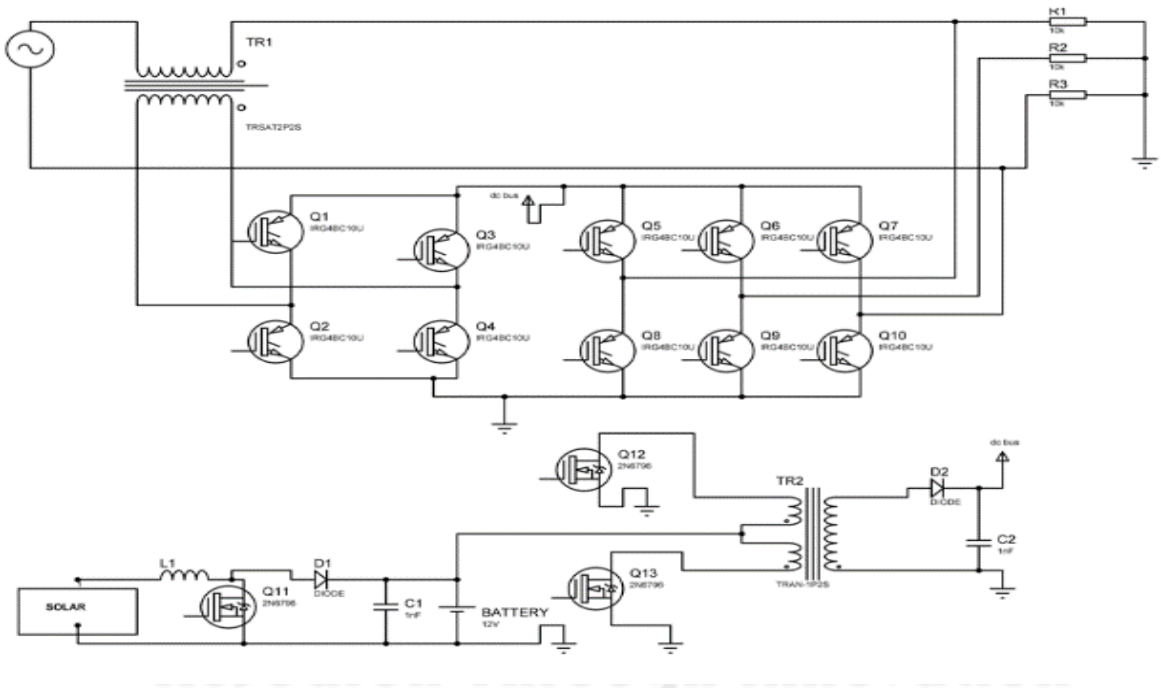

Fig 2. CIRCUIT DIAGRAM

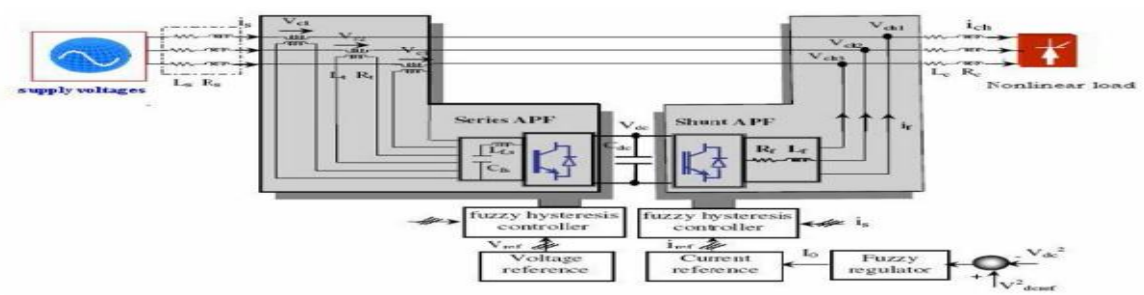

Fig 3. STATCOM Structure

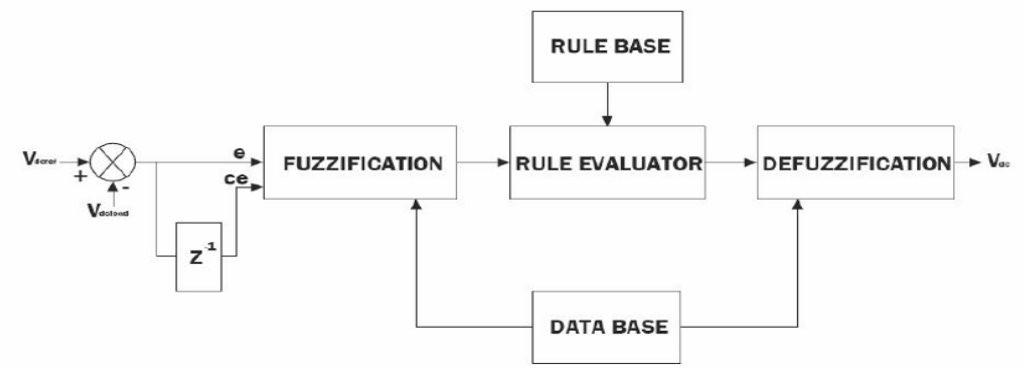

Fig 4. Fuzzy Logic Algorithm

DUTY CYCLE

- If a digital signal spends half of the time on and the other half off, we would say the digital signal has a duty cycle of 50% and resembles an ideal square wave.
- If the percentage is higher than 50%, the digital signal spends more time in the high state than the low state and vice versa if the duty cycle is less than 50%.
- Here is a graph that illustrates these three scenarios:
  - ✓ 100% duty cycle would be the same as setting the voltage to 5 Volts (high).
  - ✓ 0% duty cycle would be the same as grounding the signals as shown in figure.

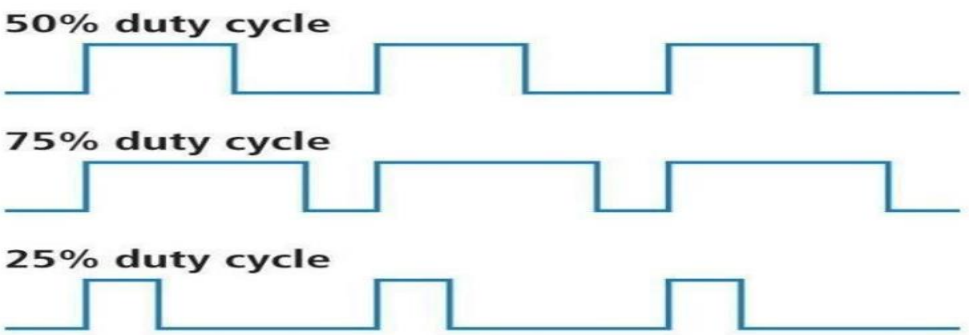

Fig 5. Duty Cycle Diagram

DC – DC Converter

- ✓ DC –DC converters are power electronic circuits that convert a dcvoltagetoadifferentvoltagelevel.Therearedifferenttypesofconversionmethodsuchaselectronic, linear, switched mode, magnetic, capacitive. The circuits described in this report are classified as switched mode DC-DC converters.
- ✓ DC-DC Converters are needed because unlike AC, DC can't simply be stepped up or down using a transformer. In many ways, a DC-DC converter is the DC equivalent of a transformer. They essentially just change the input energy into a different impedance level. So whatever the output voltage level, the output power all comes from the input there is no energy manufactured inside the converter.

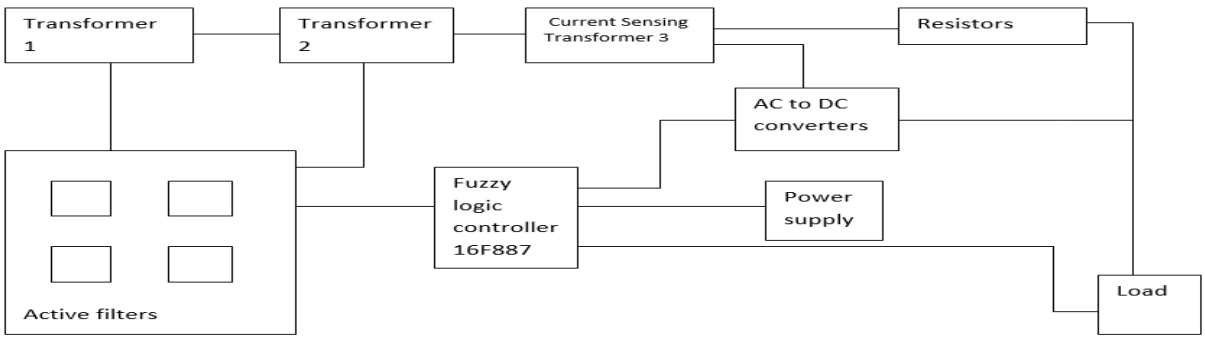

Fig 6. BLOCK DIAGRAM

POWER SUPPLY

A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

TRANSFORMER

Transformer is a device used either for stepping-up or stepping-down the AC supply voltage with a corresponding decreases or increases in the current. Here, a transformer is used for stepping-down the voltage so as to get a voltage that can be regulated to get a constant 5V.

HARDWARE REQUIREMENTS

- Transformer.
- Fuzzy Logic Controller.
- DC-DC converter.
- Active Filter.
- Load.
- Power Supply.

HARDWARE SETUP

In long transmission line voltage sag issue will be occur. The main objective of my project is to overcome this issue caused in long transmission line. In long transmission line, the entire power generated in the power station will not be delivered completely to load, this issue is called as voltage sag and also power quality issue.

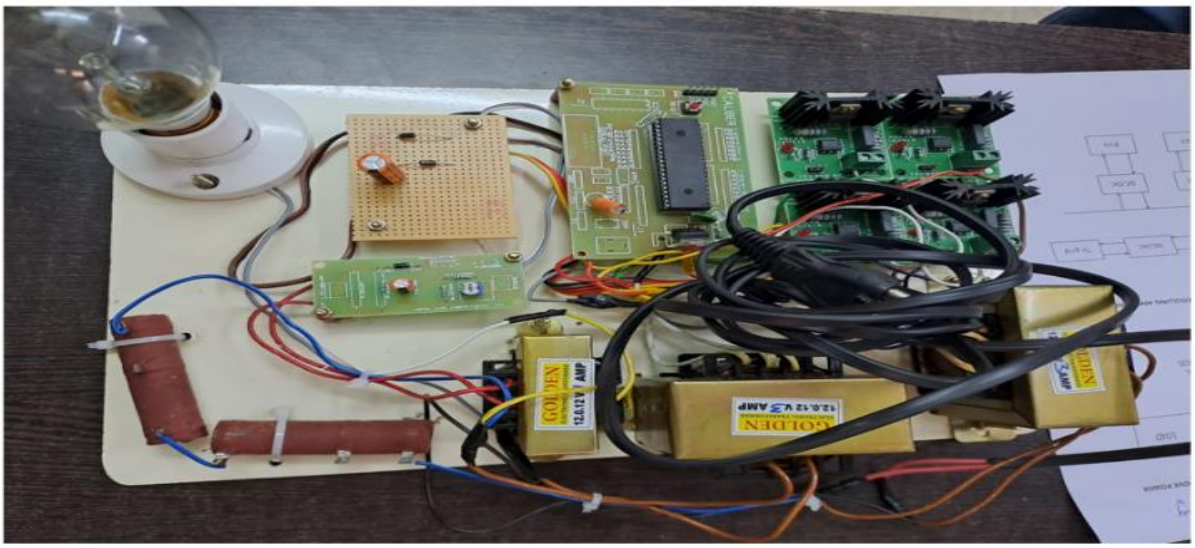

Fig 6. HARDWARE SETUP

There is also a issue called voltage swell, this will not commonly occur in the transmission line and also it occurs rarely in the case of no load. The voltage sag commonly occur in the evening time.

Now we are going to overcome this issue by boosting the output power. We are boosting the output power to solve voltage sag that occurs in transmission line by using transformer, active filter, fuzzy logic controller, sensing unit, resistance, ac to dc converter and power supply in our project.

When this above mentioned setup is included in between the long transmission line the voltage sag that occurs in the long transmission line will be sensed by the sensing unit. After sensing the voltage sag the sensing unit will sent the feedback into the fuzzy logic controller which helps to boost the voltage using four converters to certain level . If the boosting level of voltage satisfies then the sensing unit senses and stops the feedback and the load maintains the level .If the level is insufficient then again the process will repeat until the sufficient power received to the load. By this method the voltage sag that occurring in long transmission line which is also called power quality issue will be overcome.

ADVANTAGES

- ✓ Stabilize voltage of output power
- ✓ Reduce system power loss in transmission line and harmonics, voltage sag and power quality issue.
- ✓ Increase both transmission capacity and limit for transient voltage.

CONCLUSION

The paper proposes fuzzy logic controller for controlling voltage sag to improve power quality issue and to improve the distribution power system.

This result in improving efficiency and line loss will be decreased. The efficiency of the proposed controllers is established. It observe from the above studies the proposed fuzzy logic controller gives fast transient response.

By using fuzzy logic controller, transformer, filter, sensing unit, ac to dc converter the output power is boosted and this result in controlling voltage and power quality issue.

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