

# A Fuzzy Logic Control with PWM based Solar Power Generation for a Seven Level Inverter

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**Abstract** - The dc to dc power converter incorporates a dc-dc help converter and a transformer to change over the yield voltage of the solar basement beam in to two free voltage sources with multiple connections This news seven-level inverter is configured utilizing a fuzzy rationale circuit and a full-bridge power converter, associated in course. The fuzzy rationale circuit changes over the two yield voltage sources of dc-dc power converter into a three-level dc voltage, and the full-bridge power converter further believes this three-level dc voltage into a seven-level ac voltage. The dc-dc power converter incorporates a lift converter and a transformer to change over the yield voltage of the solar cell exhibit into free voltage sources with multiple connections. This model can be utilized for investigation of PV characteristics and for reproduction with Maximum power point tracking calculations. This new seven level inverter is designed utilizing a fuzzy rationale and a full bridge power converter. The fuzzy rationale circuit changes over the two yield voltage sources of dc to dc power converter into a three-level dc voltage, and the full bridge converter further believes this three-level dc voltage into seven level ac voltage. The THD in the system is also reduced.

**Keywords** - photovoltaic module, inverter, Solar, Multi-Level Inverter, Seven Level

## I. INTRODUCTION

The solar energy vitality is winding up increasingly significant since it creates less contamination and the expense of non-renewable energy source energy vitality is rising, while the expense of solar exhibits is diminishing. The developing energy vitality request combined with the likelihood of decreased supply of ordinary fills, alongside developing worries about natural safeguarding, has driven innovative work of elective energy vitality sources that are cleaner, sustainable and that produce minimal ecological impact. [4] Among the elective sources the electrical energy vitality from PV is currently viewed as the normal energy vitality source progressively valuable, since it is free, inexhaustible, and spotless, circulated over the earth and takes an interest as an essential factor of every different procedure of energy vitality generation on earth.

The power change interface is essential to network associated solar power age frameworks since it changes over the dc power produced by a solar cell exhibit into ac power and feeds this ac power in to the utility lattice. [3] An inverter is fundamental in the power change interface to change over the dc power to ac power. Since the yield

voltage of a solar cell cluster is low, a dc-dc power converter is utilized in a little capacity solar power age framework to support the yield voltage, so it can coordinate the dc transport voltage of the inverter. [6] The power transformation efficiency of the power change interface is imperative to guarantee that there is no misuse of the energy vitality produced by the solar cell exhibit. The active gadgets and inactive gadgets in the inverter produce a power misfortune. The power misfortunes because of active gadgets incorporate both conduction misfortunes and exchanging misfortunes. Conduction misfortune from the utilization of active gadgets, while the exchanging misfortune is corresponding to the voltage and the current changes for each exchanging and exchanging recurrence. A filter inductor is utilized to process the exchanging sounds of an inverter, so the power misfortune is relative to the measure of exchanging harmonic. [4]

The voltage change in each exchanging task for a multilevel inverter is decreased so as to improve its power transformation efficiency and the exchanging worry of the active gadgets. [7][5] The measure of exchanging harmonic is likewise constricted, so the power misfortune brought about by the filter inductor is additionally diminished. In this manner, multilevel inverter innovation has been the subject of much research in the course of recent years. In principle, multilevel inverters ought to be planned with higher voltage levels so as to improve the change efficiency and to diminish consonant substance and electromagnetic obstruction (EMI). [3] Regular multilevel inverter topologies incorporate the diode cinched the flying-capacitor, and the course H-bridge types. Diode-clipped and flying capacitor multilevel inverters use capacitors to build up a few voltage levels. Be that as it may, it is difficult to direct the voltage of these capacitors. Since it is difficult to make a voltage innovation in both the diode-cinched and the flying capacitor topologies, the power circuit is confused by the expansion in the voltage levels that is important for a multilevel inverter. For a solitary stage seven-level inverter, 12 power electronic switches are required in both the diode-clasped and the flying-capacitor topologies. [10][11] Topsy-turvy voltage innovation is utilized in the course H-bridge multilevel inverter to permit more levels of yield voltage, so the course H-bridge multilevel inverter is appropriate for applications with expanded voltage levels. Two H-bridge inverters with a dc transport voltage of multiple connections can be associated in course to deliver a solitary stage seven-level inverter and eight power electronic switches are utilized. [1][2]

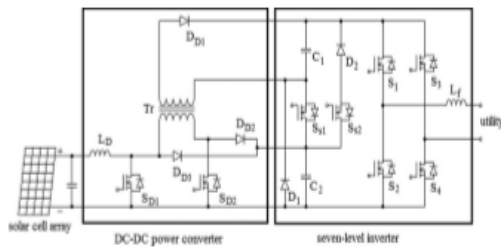


Figure 1: Configuration of the solar power generation system

The power transformation interface is essential to framework associated solar power age frameworks since it changes over the DC power created by a solar cell exhibit into AC power and feeds this AC power into the utility network. An inverter is vital in the power change interface to change over the DC power to AC power. Since the yield voltage of a solar cell exhibit is low, a DC-DC power converter is utilized in a little capacity solar power age framework to help the yield voltage so it can coordinate the DC transport voltage of the inverter. Figure 1 shows the basic configuration of the solar power generation system.

II. IMPLEMENTATION AND RESULTS

The models are implemented in MATLAB 2018a Simulink. The maximum power is computed online using a modified perturb and observe algorithm. The computed maximum power is compared with instantaneous actual SOLAR power, the error between reference (maximum) power and actual power activates ON/OFF controller with a Fuzzy controller to improve the multi-level inverter with seven levels. Therefore, the instantaneous power extracted from the SOLAR is maintained between the tolerance bands.

The central matter of fuzzy logic is to plot an information space to output space. Also, the on the off chance that announcements are utilized in this is known as rules. All rules are determined in parallel, and the rules arrange is immaterial.

The rules are valuable since it alludes to the factors and descriptive words that characterize those factors. When we need to manufacture a system than before that we ought to characterize every one of the terms and descriptors which are utilized to portray that terms. For instance, in the event that we need to state that the water is hot than we ought to characterize the scope of the temperature of the water and we additionally need to examine about the term hot.

The synopsis of the fuzzy system is that it maps the qualities in the info, it depends on the rules set and afterward give esteems in the output. We can say that fuzzy controllers are basic hypothetically. There are three phases which is incorporated into this which is input stage, preparing stage and output stage.

Information arrange maps the sensors or likewise alternate sources of info like changes and thumbwheels to the best possible function of membership and truth esteems. The handling stage contains the set of rules and delivers an

outcome for every one of the rule. After this it consolidate the consequence of the rules. In the output stage there is transformation of shared outcome once again into definite control estimation of output.

Triangular shape is the most widely recognized state of the membership functions. There is additionally other shape, for example, chime bends and trapezoidal. In any case, the shape isn't so essential. The most imperative thing is situation of bend and number of bends. There are three to seven bends which is ordinarily utilized for covering required scope of the info esteem.

The handling stage contains the set of logic rules and it is as IF-THEN explanations. In this "precursor" is the IF part and "resulting" is the THEN part. The fuzzy control system contains many rules.

Consider a precedent which is a rule for indoor regulator: In the event that temperature is "cold" warmer is "high". In this we take a reality esteem in contribution for the temperature which demonstrates reality estimation of cold and it create an outcome for the output for the warmer which is the estimation of high. Higher the estimation of error gives higher the estimation of high.

The few predecessors of the fuzzy rule sets are joined by utilizing administrators of fuzzy like AND, OR, and NOT. What's more, utilizes the base load of the forerunners, OR utilizations maximum load of the precursors and NOT is an "integral" function which is acquired by subtracting the membership function from 1.

In equipment the rules are understood parallel and in programming it is comprehended consecutively. There is additionally a procedure name defuzzification which changes over the semantic incentive to numeric esteem. There are a few strategies for this. The most mainstream strategy is "centroid" technique. In this the fresh esteem is given by "focal point of mass" of result. Another technique is "stature" strategy. It takes greatest giver esteem. The rule which is supported by centroid technique is finished with the best territory output. The rule which is supported by stature technique is finished with the estimation of most prominent output.

A curve which defines that how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1 is called membership function (MF). A fancy name for simple concept is universe of discourse denotes the space of inputs. Figure 4.1 shows fuzzy logic toolbox for defining the rules in the fuzzy fis file.

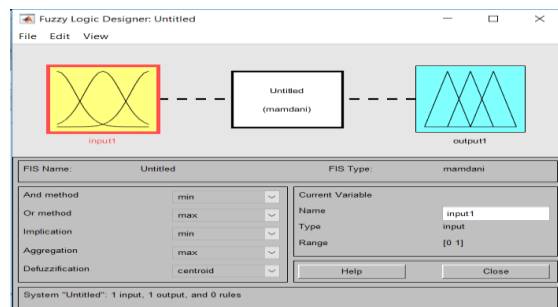


Figure 2: Fuzzy Logic Toolbox

In figure 3, the implemented model for solar based MLI is shown in which we have separate stages for dc to dc converter and then dc to ac converter, which increases cost and complexity and giving a distorted waveform in output.

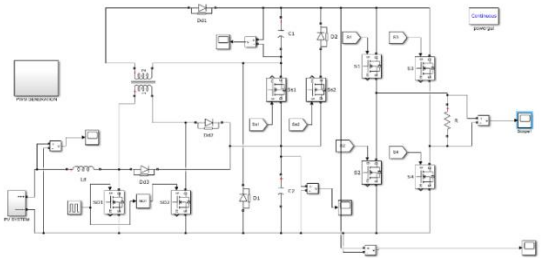


Figure 3: Model Implemented for Solar based Seven Level Inverter

In figure 4, the output for solar converter dc to ac is shown, which clearly shows a distorted waveform.

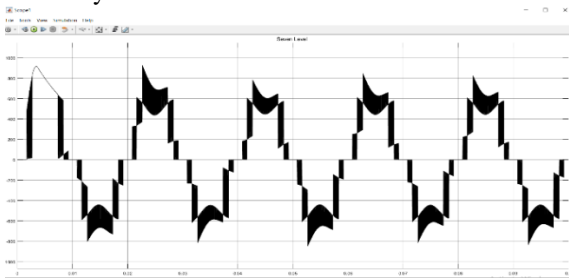


Figure 4: Output Waveform for Solar based Seven Level Inverter

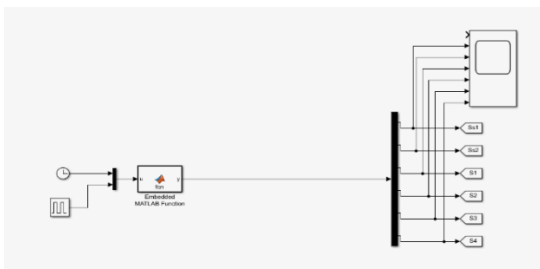


Figure 5: Control PWM for Solar based Seven Level Inverter

The figure above shows the control PWM for the inverter based on two stages and single PV solar panel based system.

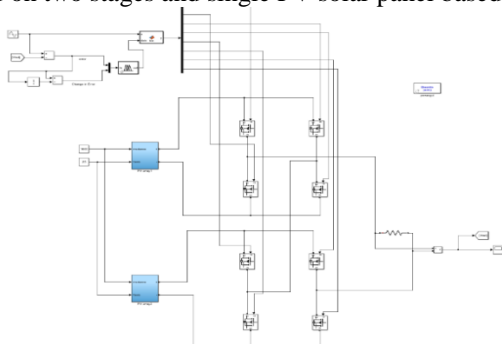


Figure 6: Proposed Model for Solar based Seven Level Inverter using Fuzzy Logic

The figure 6 shows the proposed model with two arrays and h bridge and fuzzy logic based control scheme.

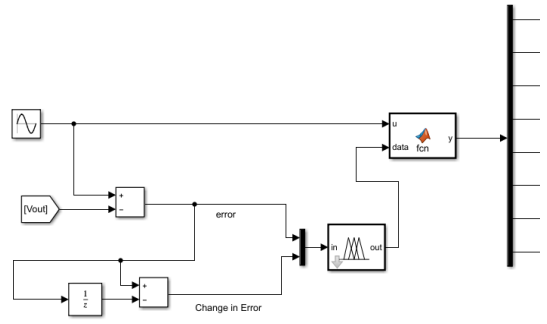


Figure 7: Control Technique proposed for Solar based Seven Level Inverter using Fuzzy Logic

The figure 7 above shows the control technique using the fuzzy logic system for reduction in the error of the system.

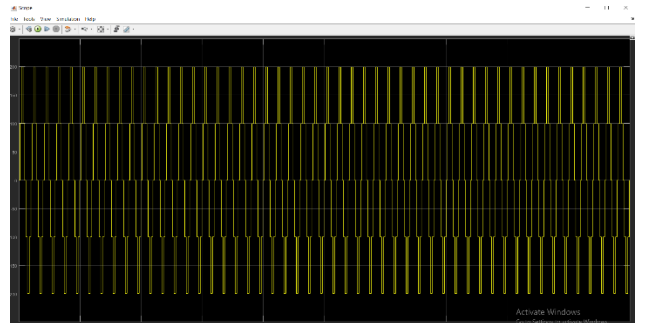


Figure 8: Output Waveform proposed for Solar based Seven Level Inverter using Fuzzy Logic

The output waveform for final seven level inverter is shown in figure 8.

### III. RESULTS

This section shows the THD of the two implemented models and proves that the model with fuzzy logic shows better output when compared to the simple one. This is shown in figure 9 and figure 10.

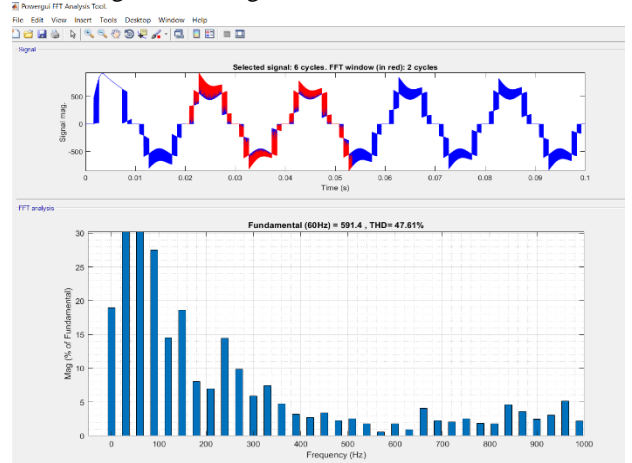


Figure 9: THD for Solar based Seven Level Inverter



Figure 10: THD for Solar based Seven Level Inverter using Fuzzy Logic

#### IV. CONCLUSION

The use of fuzzy logic in the solar based MLI has improved the performance of the multi-level inverter. A solar power age framework to change over the dc energy vitality produced by a solar cell exhibit into ac energy vitality that is bolstered into the utility. The solar power age framework is made out of a dc– dc power converter and a seven-level inverter. The seven-level inverter contains just six power electronic switches, which simplifies the circuit configuration. Besides, just a single power electronic switch is exchanged at high recurrence whenever to produce the seven-level output voltage. This diminishes the exchanging power misfortune and improves the power efficiency. The voltages of the two dc capacitors in the seven-level inverter are adjusted consequently, so the control circuit is simplified. The solar power age framework produces a seven-level output voltage and outputs a sinusoidal current that is in stage with the utility voltage, yielding a power factor of solidarity. Furthermore, the solar power age framework can successfully trace the maximum power of solar cell cluster.

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