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Design Model of Photovoltaic System using PID Controlled Multi-Level Inverter

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ABSTRACT

Solar energy is considered as the energy that will rule the world in coming time Various modern algorithms have been designed by different researchers to get the maximum output from the PV such as incremented conductance method, perturbing and observing method, sweeping current type method, constant voltage type method, and comparison method etc. various authors intend to produce a better algorithm - reliable and efficient to suck the maximum possible energy from the PV panel. It is obvious that though renewable energy is available at free of cost it involves much of capital cost. Hence it is very important to improve its efficiency. Since these energies are natural resources, the availability is not constant. There will be always fluctuations in the output. The paper presents different stages of Solar Power plant are combined and a simulation of PV power system integrated with grid is implemented and all the results are displayed for the comparison. The results obtained have shown the robustness in term of THD level, stability of different parameters, and the tuned D.C. Voltage of the PV system with maximum power of the PV capacity.

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I. INTRODUCTION

The Study of Photo Voltaic System Integrated with power Grid is targeted on renewable energy system branch due to its numerous advantages. The advantages of renewable energy sources are such as it solves the environmental issues by helping the environment to keep clean. It helps in preserving of non-renewable sources for future generation as they are limited source of energy. It does not require much of running cost. The capacity of this renewable source of generating plants range can vary from smaller to bigger one and it can be installed very easily according to the availability of the source and location.

The points which are discussed above are the root cause of search of renewable source of energy conversion techniques. The sun (Solar) energy has a huge demand (Potential) in future that, it is naturally available and this never ends up (or) never goes to out of stock condition. The fossil fuels which are considered to be the main source of energy are now a day's slowly getting decayed in availability and it has the ability to become the fuel (Source) for the future.

The main advantages of renewable energy sources are that, it is naturally available and this never ends up (or) never goes to out of stock condition. The fossil fuels which are considered to be the main source of energy are now a day's slowly getting decayed in availability.

Not only the unavailability of the fossil fuels is the reason behind switching to renewable energy sources but also the pollution produced. The by-products of produced by these fossil fuels are dangerous to the environment and to the humans. This forces any country to adopt clean and green energy techniques and mechanisms. As the present environmental condition forces us to move towards the green energy, we are in the situation to adopt renewable energy which is an important life saving energy. When this type of energies are targeted to produce in large amount of electricity then there are various problems arises such as poor efficiency, energy storage issues (due to unavailability of large capacity of energy storage device) etc. The continuous variation in the input source (especially in Solar energy due to

variation in the sun radiation) (Saket et al., 2016) connecting to ON grid is the biggest problem. Due to synchronisation issue between ON grid system and the power plant output it end up with poor efficiency.

This poor efficiency makes the payback period too long. And application of energy efficient techniques increases the plant cost which may not be affordable. The recent study reveals that in India in the upcoming years the demand of the electricity by the consumers will be increased due to increase in huge population potential. Even some studies have been witnessed that in the year of 2025 the electricity requirement by the consumers of India will be increased by a factor of 2.25 (Dasha et al., 2015). And by this factor it is almost the demand requirement is more than the double as the present requirement. Now a day's the renewable energies is the life saving energy which are playing a vital role.

II. Literature Survey

The connection topologies of PV system are different types. The different topologies of connections of PV systems have its own their merits and demerits. And also it has its own technical challenges, technical benefits in terms of efficiency and other technical aspects. The different PV system connection topologies are centralised topology, master slave topology, string type topology, team type topology, multi string type topology and modular type topology (Kannabiran et al., 2016). The study of most possibility of impacts of PV system on network of existing commercial grid system is considered. This study is useful in providing best operational solutions for the problem of impact on grid system. The major electrical impacts of characteristics are considered as follows, availability of the plant, capacity of the PV plant, Penetration level of the PV plant, short term fluctuation level of the PV plant, suitability of the PV system etc. are the factors.

Apart from the electric quantity impacts some other general impacts are also affects the grid connected system and they are, optimal placement of Photovoltaic system, defined sizing of the Photovoltaic system and sustainable suitability of output power usage of the Photovoltaic system (Omran et al., 2010). The impacts of high voltage levels and large scale Photovoltaic system penetration on the stability and security of power system are discussed in reference (Seo et al., 2009). The large scale PV generation also affects the electric quality, voltage & frequency stability, power flow control, latest necessities to power system test environment and simulation technologies requirement, codes and standards for revising the operational standards as per the updated systems, dispatching methods are discussed in reference (Prajna et al., 2010).

The experimental results of reference (Ayaz et al., 2015) shows that the without disturbing the specific required criteria in the standards, the grid connected multilevel inverter in capable of detecting islanding condition and then it start activate the protective devices. The effective islanding feed forward compensation also gas been proposed in it. As a first step the algorithm of MPPT can be made with hybrid combination so that the smart way of switching can be possible so that the assurance towards the maximum power harvesting for a longer period efficiently. An efficient way of achieving the above said point is by having hybrid algorithm with soft switching technology for achieving maximum efficiency under different climate conditions. By this method the duty cycle of (DC-DC) converter can be easily changed or modified automatically according to level of requirement (Henrique et al., 2009). There is another researcher who has proved that hybrid algorithm switching technology between P&O and constant voltage algorithm improves the efficiency significantly (Carols et al., 2017). The different researches have been carried out using P & O and INC methods of MPPT algorithms (Ramalu et al., 2016). The latest approach in this field of research is that an artificial intelligence technique based algorithms such as use of techniques called fuzzy logic control, neural network control, soft computing technique, ARDUINO platform technique etc. (Kim et al., 2017).

III. Methodology

A simple H-bridge generally consists of three level inverter build in it. So n case if the more level of inverter operation is needed then the more number of conventional H bridge inverter can be assembled in series or parallel to obtain more than three level inverters. The more the number of inverter level then it also requires the number of switching devices accordingly hence the number of switching devices required for five level will be as double as three level inverter. As we know that the inverters well controlled as per the required signals using PI or PID controllers hence it requires PWM generation circuits. So the more the number of level of inverter the more PWM generation circuits according to the level needed by the logical operators through the carrier signal. Figure 1 shows the MATLAB Simulink model of the multi-level (five level) inverter which consist of conventional H bridge inverter

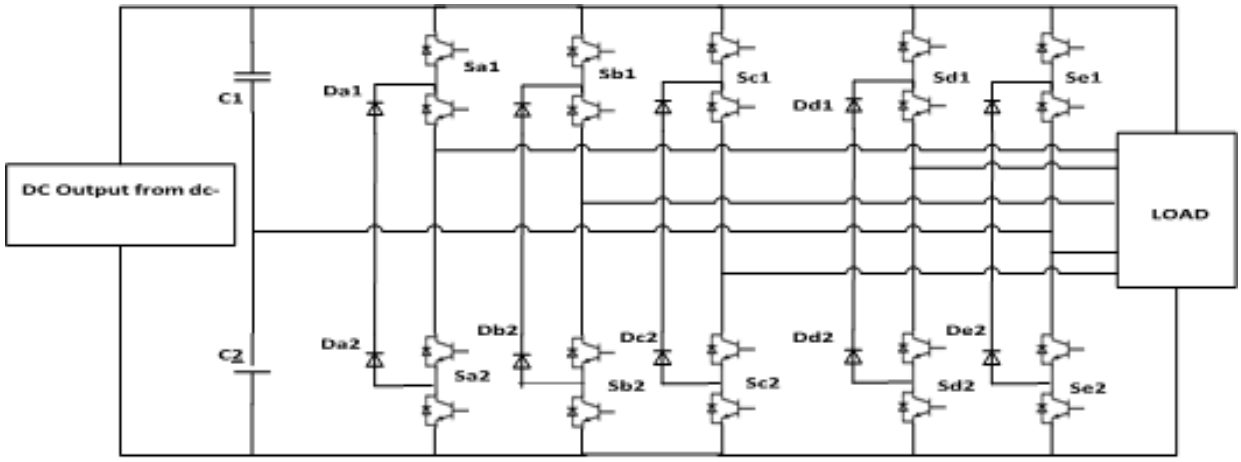

Figure 1 Matlab simulation of 5-Level Multi level inverter

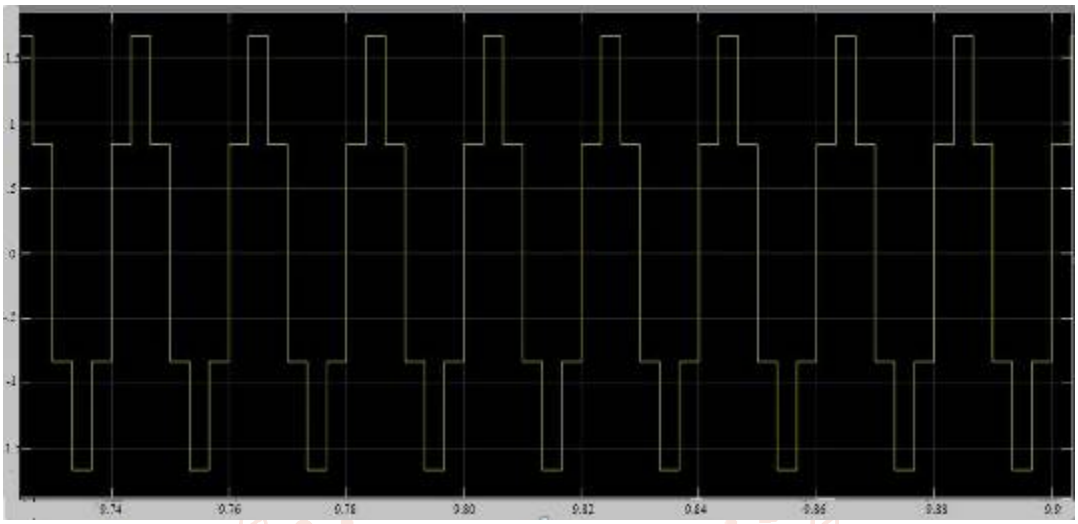

Fig 2 Represenatation of pulse given to inverter

Fig 1 shows the Matlab simulation of 5 level multi level inverter and Fig 2 shows the pulse given to the inverter.

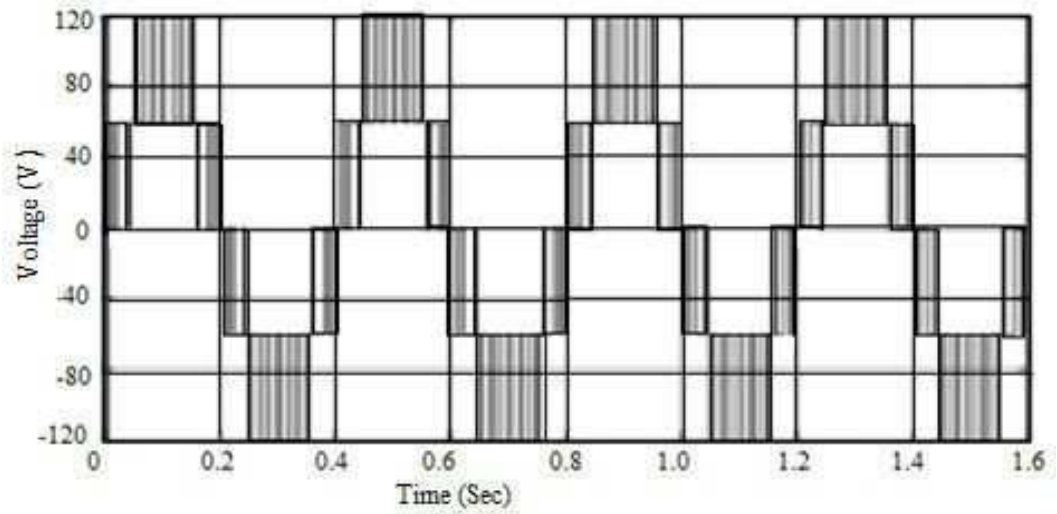

Fig 4:- Voltage waveform

Fig 4 depicts the voltage waveform at the end of inverter.

IV. Result :-

The specifications can be varied and adjusted according to the requirements. To obtain the stable output the specifications are adjusted accordingly. The PID controller which is designed is adopted with the MATLAB simulation realisation of multilevel inverter and its responses are displayed for the comparison. It can be observed from Fig 6 that the performance of the circuit has been increased with the proposed mythology. The Proposed complete simulation model with best possible combination of proficient techniques at several levels of the PV based power plant is simulated and results are presented.

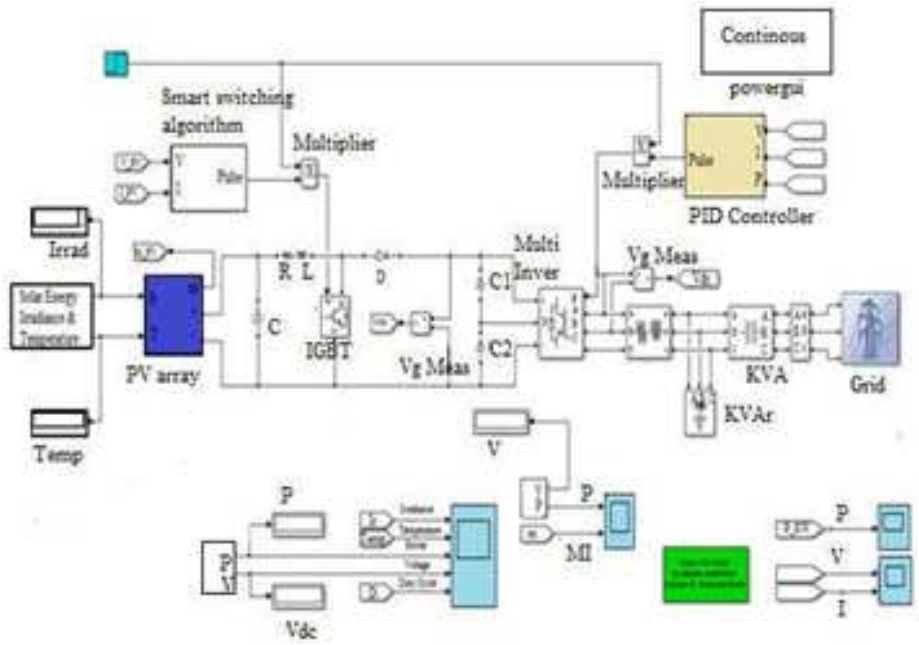

Fig 5:- Matlab Simulink of multi-level inverter with PID Controller

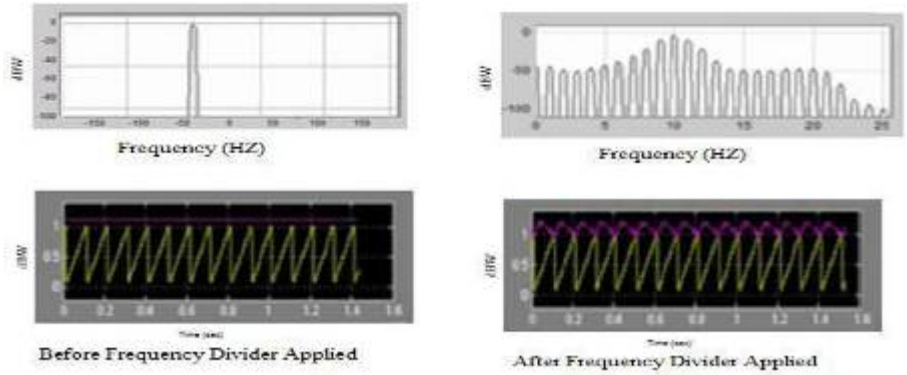

Fig 6:- Performance of Circuit with PID Controller

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