International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

Analysis and Simulation of Hybrid Power Generation using Pedal Generated Electrical Power for Integration with Solar

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Abstract - *Electric energy is the most critical resourceful and popular form of energy instead of only modern society is hugely determined by electrical power, but also rural areas are coated to boost the rural atmosphere. The main objective of this research work is to investigate the development of a new hybrid design layout and its performance by simulating it in MATLAB through the application of load. This paper shows the establishment of the comparative study of Photovoltaic Applications with low dc input voltage with pedal generation techniques., In this research IGBT is used in place of MOSFET. With these improved performance, the converter can maintain high efficiency under low power and low input voltage condition.*

Key Words: Pedal, Controller, Power Conditioning System (PCS), Solar, Simulation.

1. INTRODUCTION

In modern era there are many remote areas in India have no access to electricity. Also, if there is electrification, then it is available or very short time in a day. The cost of setup and maintenance of transmission lines in those regions is because of low population densities. Some of these areas won't have access to reliable power even in the next ten years. Therefore alternate means of electrical energy will need to be utilized with enhanced power quality and preparation at the local level. One such choice is to produce electrical energy using Manual Charkha (Pedal generator) as per the Power Generation System.

Small scale power plants are set up under the village energy security programme (VESP) which was implemented by Ministry of new and renewable energy (MNRE), India to achieve the requirement of power. This plan intends to arrange unique sources of renewable energy based systems to satisfy energy requirements of villages in an efficient, cost effective and reliable manner.

Some neighbour countries like Bangladesh is a working on the development of new small power generation techniques that may be used in rural areas without harming environment [1] [3]. Study shows that, Pedal generation unit consists of an Electro-Mechanical system. This system demonstrations the conversation of kinetic energy to electrical energy by using alternator and stores it by using battery [1] [3].

In this paper we analyze the simulation of the hybrid system that uses of the Solar powered system and pedal power generation.

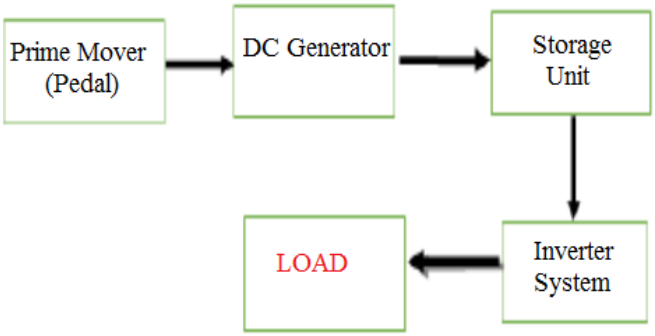

Fig. 1 Block diagram of Pedal System

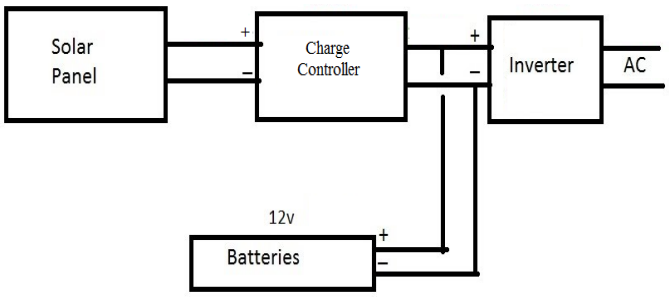

Fig. 2 Block diagram of Solar System

Above figures shows the different power generation techniques, i.e. Solar generated power and pedal generated power. Next we see the integration of these two sources into a single power generation unit controlled by a power conditioning system that regulates th power as per the load.

2. PROPOSED MODEL

Here, Solar PV array and the pedal mechanism is combined by the power conditioning unit that always compare the output of both the generating sources and regulates power as per the load need. Rotating a coil inside a magnetic field induces a voltage in the coil terminals, which generates power to supply a load.

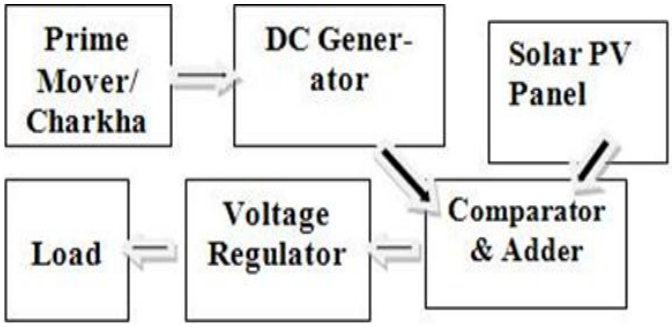

Fig -3: Proposed Model of Hybrid system

3. OPERATING MECHANISM OF PROPOSED MODEL

To understand the working mechanism of proposed model, we have to understand it individually.

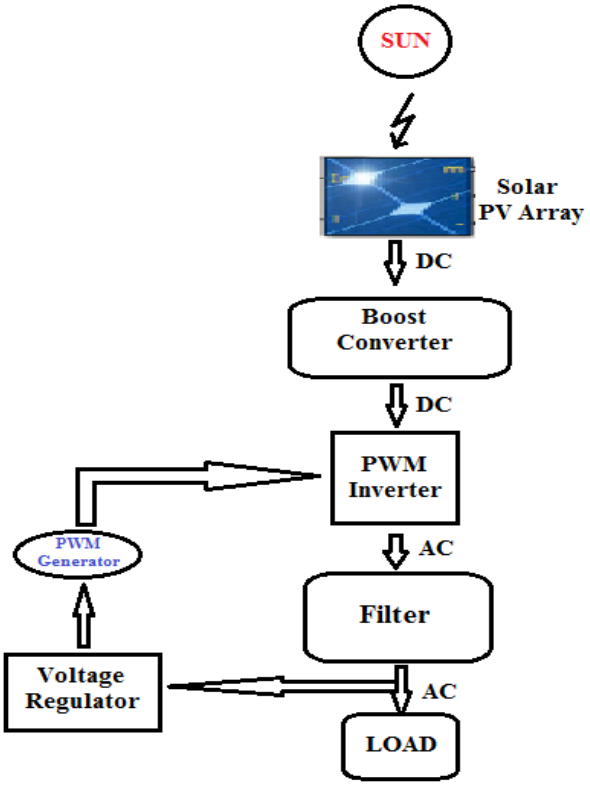

Fig. 4- Flow chart of Solar based Boost converter.

Here, above shown figure is of solar connected boost converter. In the above circuit model, it is clear that solar is working as source. Here, the solar pv array generates power at particular irradiation and temperature throughout the day. When there is insufficient illumination to manage load requirements, then the pedal generation fulfills the demand.

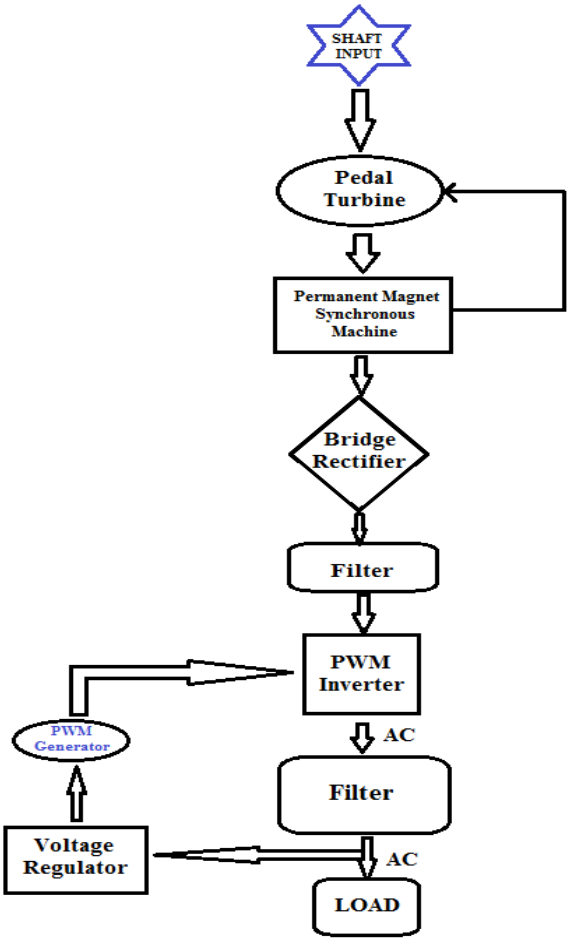

Fig. 5- Flow chart of Solar based Boost converter.

Here, pedal is rotated by any external means. These external means may be the wind or flowing water or the mechanical shaft or by human body movement. Now, the rotation pedal fed mechanical energy to the shaft of the permanent magnet synchronous machine. Here, the synchronous machine convert the mechanical energy into the electrical energy . The output of the synchronous machine is continuously monitored and compared with desired power for load. This process provides the constant and regulated power.
Comparator unit is provided to compare the load requirements with the available sources.

Here, the electrical energy is defined as the total work done. [3][7].

Electric Energy = electric power × time (1)

Electric Power = Voltage × Current = V i (2)

Thus the formula for electric energy is given by:

Electric Energy = P × t = V × i × t

=i^2× R × t =(V^2 t)/R (3)

A generator forces current to flow through an external circuit. Many motors could be driven to generate electricity and often make generators working [3][8]. Efficiency is measured as a ratio of the performance to an perfect machine's functionality.

Efficiency = (Measured Performance)/(Ideal Performance)

The power can be measured by the power equation of the fly wheel every second. In terms of rotational energy, it can be written as [3]:

Efficiency, η = (V×i Watt)/(1/2 I × ω^2 Joule/Sec)

4. SIMULATION

In order to verify the effectiveness of the anticipated converter, the converter was designed in MATLAB/ SIMULINK environment

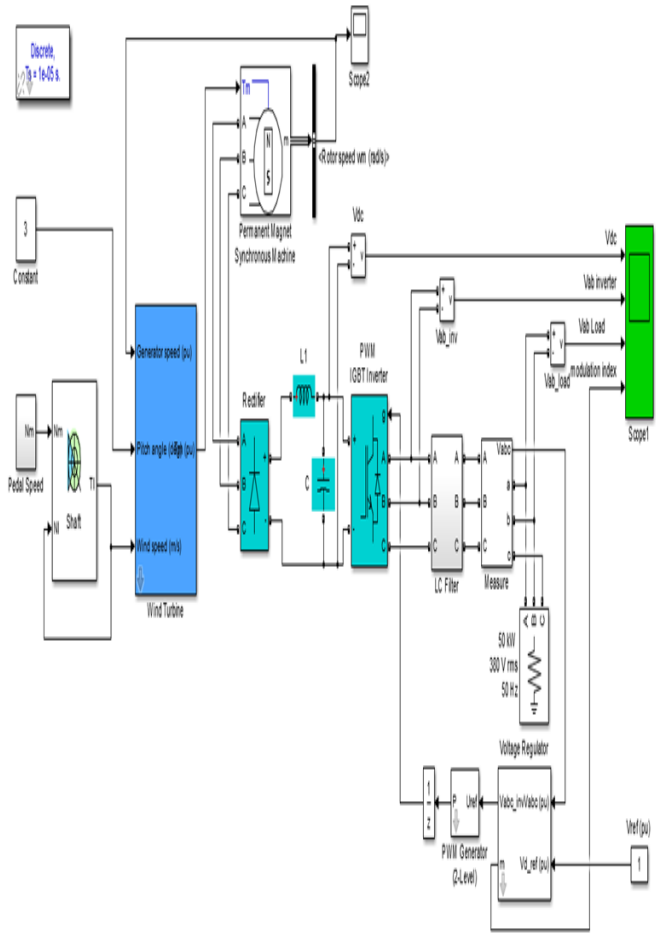

Fig. 6 Simulation diagram of pedal based high boost ratio converter

Figure 6.3 shows the output voltage waveform of anticipated pedal based high boost ratio converter. Result of this simulated model is given below.

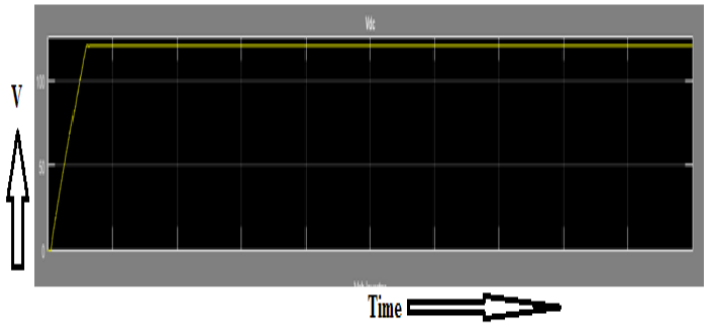

Fig. 7- Graph between DC voltage vs time for solar based converter

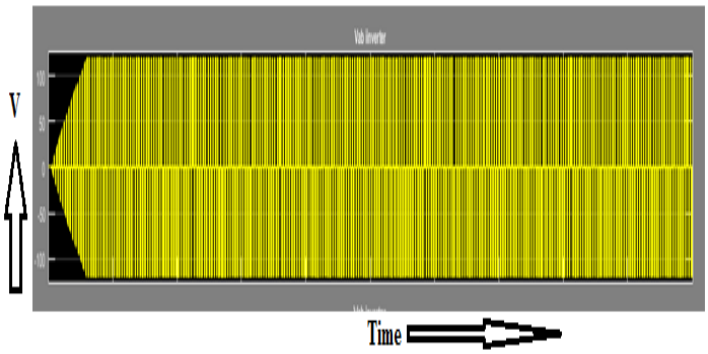

Fig. 8- Graph between inverter voltage vs time for solar based converter

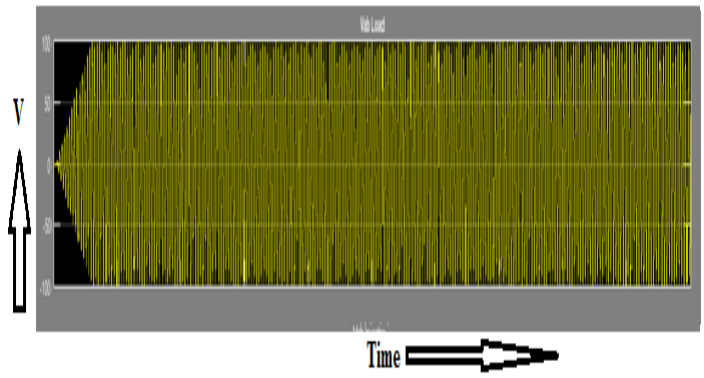

Fig. 9- Graph between load voltage vs time for solar based converter

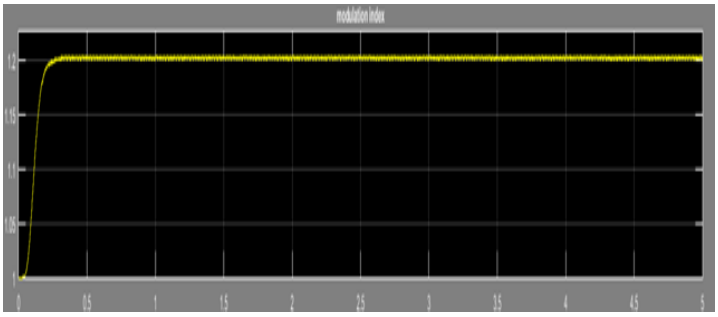

Fig. 10 - Graph of modulation index

From above waveform it is clear that pedal based boost converter is more significant and efficient than the solar based boost converter.

Here, pedal based boost converter gives smooth output. Also no such fluctuation in voltage as we see in solar based boost converter. There is no steep rise or steep fall in waveform obtained from pedal based converter. On evaluating the result of both boost converters, we can conclude it in a comparison table. Comparison table with pro and cons are given in the table given in conclusion.

5. CONCLUSIONS

This paper presents integrated model and feasibility analysis of High-Boost Ratio Hybrid Transformer DC-DC Converter for Photovoltaic Applications with low dc input voltage with following features and benefits with solar and pedal generation. Since using IGBT in converter, it gives better performance, less distortion in output which causes low harmonics injects into the power system so better efficiency of the converter.

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