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# MATLAB/Simulink Simulation of Renewable Energy Distribution System Using MPPT

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**Abstract**
In general, conventional energy sources are not easily refilled and are therefore are naturally exhaustive. That means that they are gathering finite resources that would eventually decrease. As a consequence, energy supplies would be scarce if we rely entirely on these non-renewable sources of energy. Renewable energies, commonly referred to as non-conventional energy sources such as wind, geothermal, hydroelectric and solar, are non-exhaustible and can be replenished. Their only drawback, along with its high installation and maintenance costs, are their intermittent nature. It is always very important to note that the final product requirements are noticed with regard to the constant development of energy systems, and that this paper is therefore focusing on renewable energy storage systems. In essence two renewable sources of energy are being incorporated, namely solar and wind, which lead to battery as the power source being used in an unpredictable manner. The energy is supplied as a backup source at intervals from the two renewable sources. For maximum power output, MPPT is used. The environmental benefits of these energy resources are widely understood and widely recognized. The monotonous long-term availability challenges regarding the restriction of the location of finite fuels have no significant impact on renewable energy resources; however, they involve different problems such as their interdependence on non-consistent flowing resources.

**Keywords:** Renewable energy, wind energy, solar energy

## 1. Introduction

With growing energy demand in the different sections and a reduction in affordable energy resources, focus have been shifted to renewable energy resources for energy generation. Renewable sources dominate the energy system worldwide. Generally, energy from sun, wind and water and fossil fuels are included in these sources (Singh et al., 2016). In order to be able to maintain at a certain level, effective distribution and energy generation is required. There is a focus on the issue of renewable electricity variability. But that only applies to renewables to a certain extent. These include both solar photovoltaics and wind. Their importance therefore depends on a variety of the following categories:

- Renewable energy system penetration
- Balance of the system and plant.
- Comprehensive system connectivity
- Flexibility on the demand side

The growing penetration and growth of advanced information on intermittent sources of renewable energy generally indicates how the loads responsive to optimize asset and source utilizations is managed (Vahedipour et al. 2017). Nigeria is a developing country thus, in order to manage and support the country's growth in order to compete worldwide, the country is in need of an option in the area of renewable sources to improve power capacities for strong growth (Bugaje, 2016). Wind, solar, hydro, geothermal, and other sources are high in terms of energy potential from inexhaustible sources (Saha et al. 2014). The prices fluctuate accordingly. The Indian government should start and implement a model that is technologically sufficiently mature also to possess resources potential.

## 2. Literature Review

Over the years, the sources of renewable energy have become extremely important with respect to growth, comparable to the growing demand for coal and wood. Renewable energy production was estimated as 19 percent in 2007. Although 16% are mainly due to electricity via water and therefore the production of wind and photovoltaic energy is very promising. Certain features should be included in the renewable energy supplied to the plant. The main thing is that the consumer receives minimum prices. The cost of energy is otherwise increasing and affecting different industries, hence adversely affecting the economy (Singh et al., 2016). The other feature is energy reliability. For adequate and safe energy supplies, certain qualifications should be applied to power infrastructure which include the generation, transport and distribution systems (Ruciński et al., 2016). New studies have emerged on non-exhaustible energy research and its use in urban and rural sectors as a result of the increasing need for electricity and the reduction of non-renewable energy resources (natural gas, coal). Inadequate areas in which the network is not possible to connect, but in large proportions renewable energy, such as solar, hydro and wind, may be used as electrical power generation (Spurrier et al. 2012). Due to their advantages in production and distribution, solar and wind power have proven to be a great alternative. Simulation with the MATLAB software takes place in this paper. The plant has been supplied with two sources of renewable energy. Solar and wind sources belong are the sources. Since unconventional resources are intermittent in kind, a battery backup is provided.

## 3. Methodology

The expansion of wind and solar resources as a source of electric power has played an important role during recent years (Gow et al., 2019). These technologies are therefore designed to enhance reliability, consistency, unpredictable growth and cost efficiency. The fastest emerging section on the electricity market has therefore been solar and wind generation (Reichling et al., 2018). In our country, PV and wind power production in contrast to other energy alternatives have achieved a high degree of gain and accessibility.

The MATLAB was used and simulated with the solar and wind power generation system. There is also a supplementary battery that acts as a storage system and supplies the plant once wind and solar power is switched off. The distribution of energy from renewable energy sources is based on time.

Figure 3.1 shows the block diagram of the distribution system for renewable energy which includes both sources of energy and the battery return.

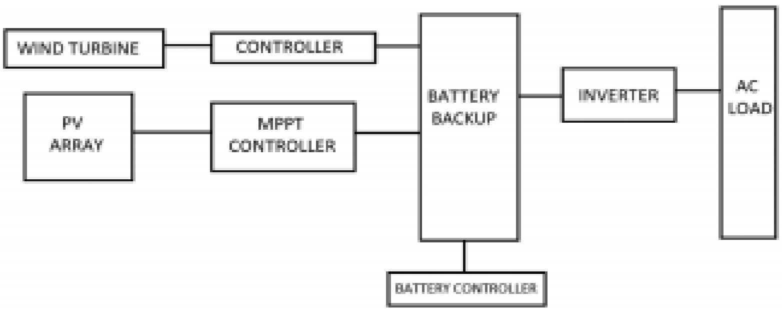


**Fig. 3.1:** Renewable energy distribution system.

3.1 System Description and Modelling

The three layers of our model are basically:

- The physical power layer.
- Layer of control.
- Application layer.

3.2 Modelling and Design of Wind Turbine

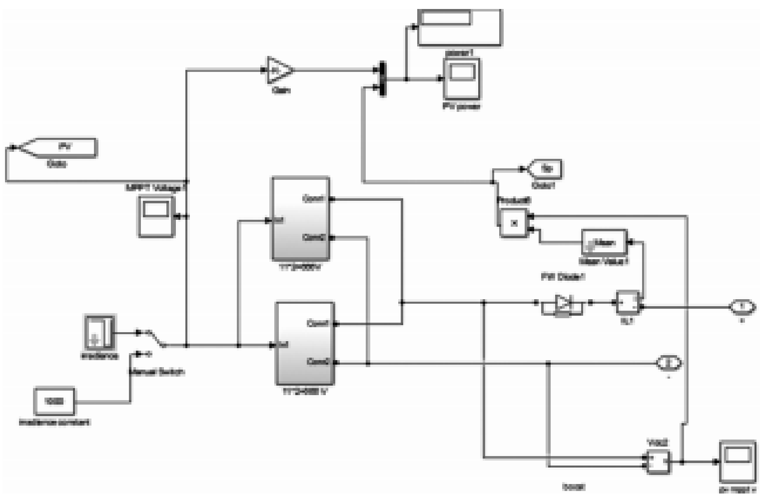

**Fig. 3.2**: Subsystem implementation of PV module.

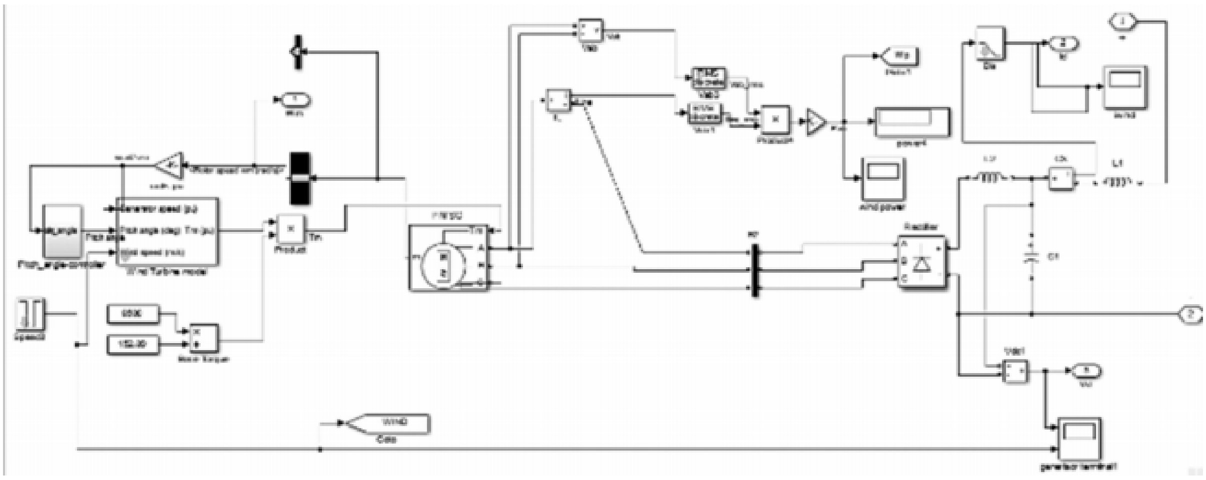

**Fig. 3.3:** Subsystem implementation of wind turbine module.

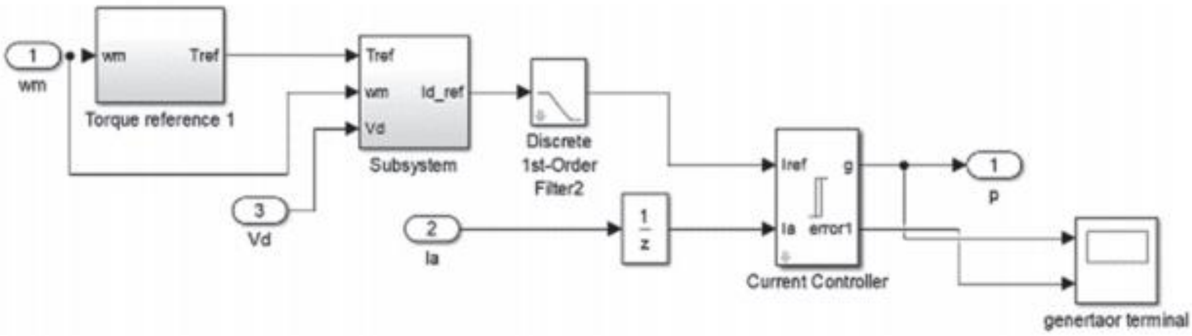


**Fig. 3.4:** Subsystem implementation of the MPPT controller model.

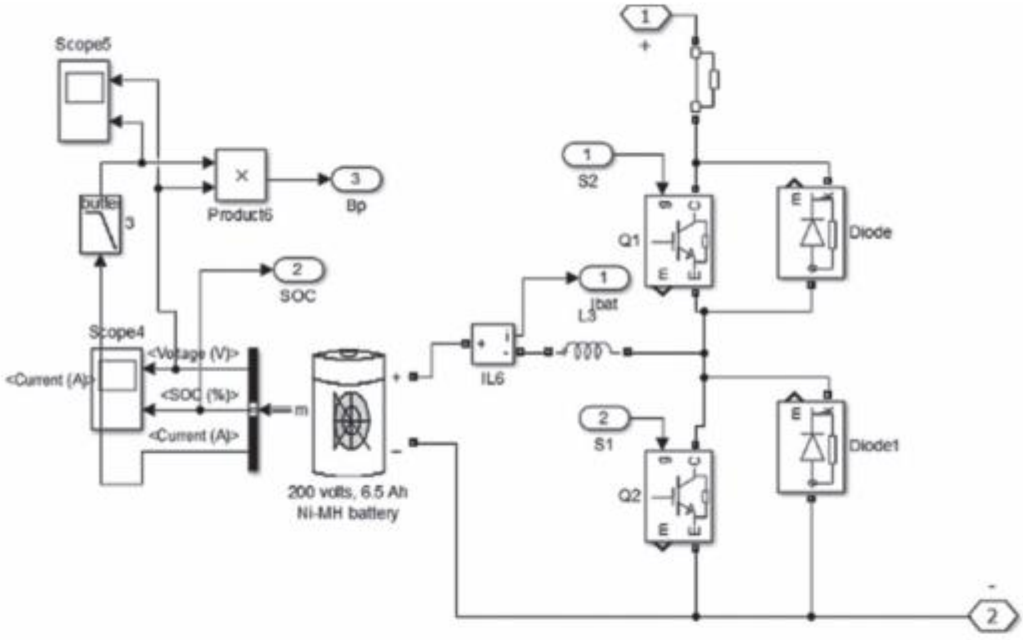


**Fig. 3.5:** Subsystem implementation of the battery

Where the pm is a mechanical turbine output power, Cp= turbine output coefficient performance, $\lambda$ = rotor blade tip speed ratio, $\beta$= pitch angle of blade, $\rho$ = air density, A= swept turbine area and V= wind speed.

The input used in the proposed model is the wind speed and the pitch angle; the output is therefore the torque applied to the shaft of the generator. The Permanent Magnet Synchronous Generator (PMSG) is a wind turbine generator that eliminates excitement loss due to the presence of a permanent magnet because of its capacities. The MPPT controller is designed to operate a module at its highest power point, as shown in Figure 5 with MATLAB.

### 3.3 Modelling and Design of Battery and Inverter

The battery supplied energy backup. The solar and wind power systems also charge the battery in turn, according to their time frame (Figure 3.4). The main objective of the inverter is to transform the battery's dc power into3-phase ac power supply (Figure 3.5). The demands for load are met with this electricity in an emergency when the wind or solar power generation is either lacking.

## 4. Result and Discussions

The wind / photovoltaic system integrated model and power controller has been simulated. Solar irradiation and irradiance constant is the input for the solar panel. Figure 4.1 illustrates the power supply of the solar system. The output power is therefore shown in Figure 4.2 using the MPPT Controller. The wind turbine's power output depends on the wind speed and the angle of pitch. Figure 4.3 shows this. Figure 4.4 shows the power output using the wind turbine MPPT controller.

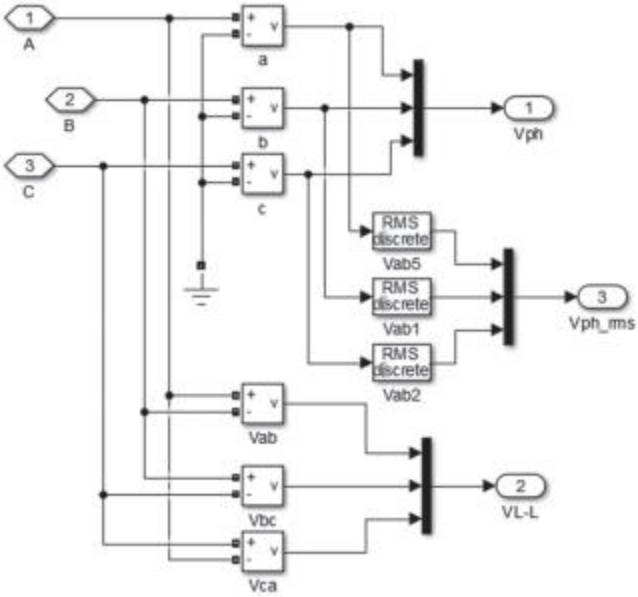


**Fig. 4.1**: Subsystem implementation of inverter controller

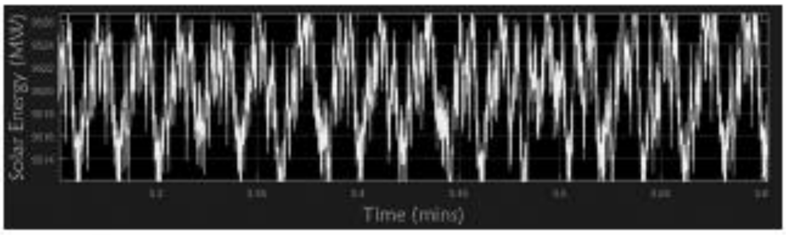


**Fig. 4.2:** Solar output power.

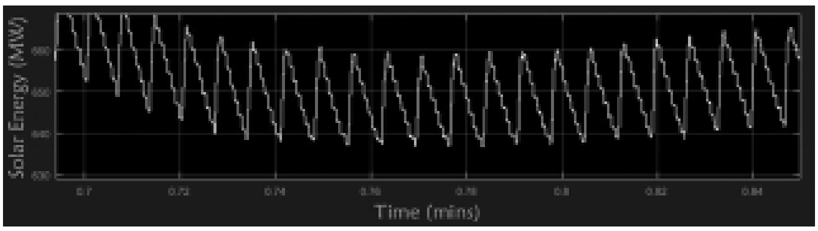


**Fig. 4.3:** Solar MPPT output power.

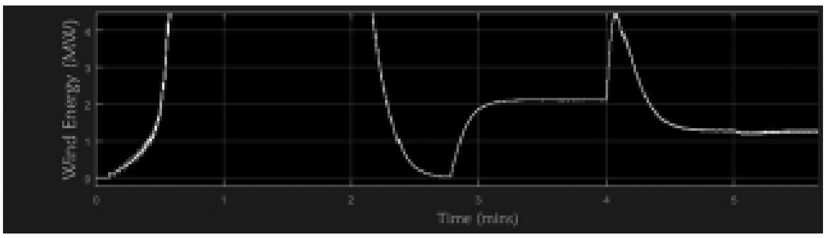


**Fig. 4.4:** Wind output power.

The battery supplies the power backup (Figure 4.5), therefore the battery is charged in the time that the solar or wind generates energy for the plant. The battery starts discharging once renewable sources are shut down, by supplying power to the load plant. Figure 4.6 shows the plot of the power output. Figures 4.7 and 4.8 respectively illustrate the total Simulink model and output plot from all three sources–wind, solar and battery.

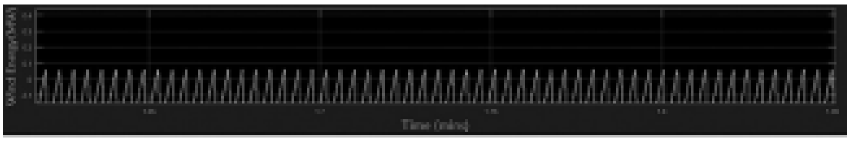


**Fig. 4.5:** Wind MPPT output power.

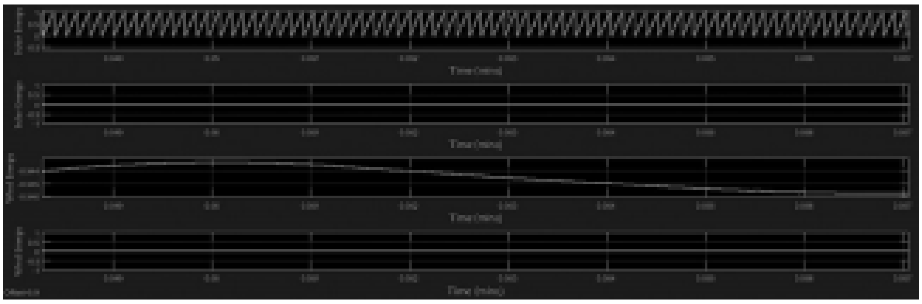

**Fig. 4.6:** Battery output power.

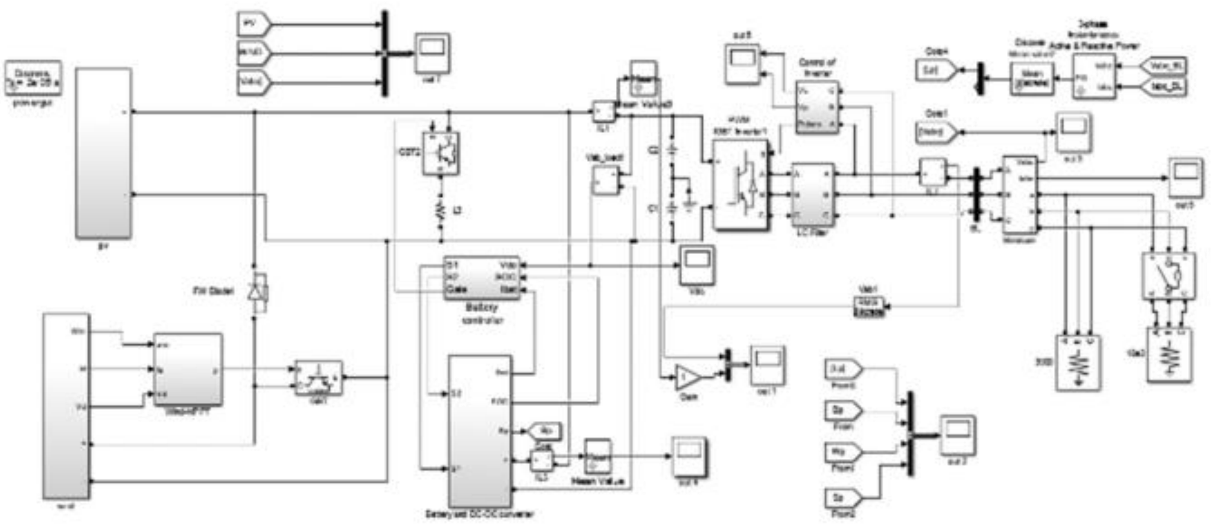

**Fig. 4.7:** Simulink model.

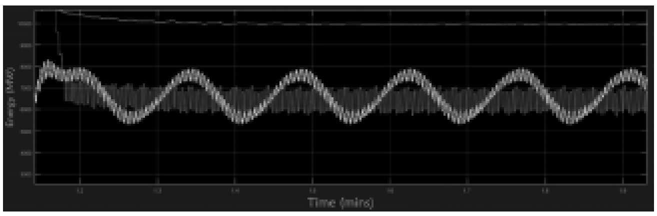


**Fig. 4.8:** Renewable energy power generation.

**5. Conclusion and Recommendation**

Our country faces the energy crisis, because non-renewable energy sources are continuously depleted, as well as the lack of technological development in the non-exhaustible sources sector. Human development and related activity enhances our atmosphere with CO2 and other harmful emissions from global warming. Hence, there has been little or no harmful emissions from renewable energies, and it is therefore acting as the' clean energy life cycle.' The study of electricity generation is therefore oriented to renewable energy sources. We developed in our paper a hybrid power system with the use of two renewable energy sources, solar and wind power and backup batteries. The system is modelled and implemented with the package MATLAB / Simulink. The power available from PV and wind systems depends in large part on radiation from the sun and wind speed. The battery back-up was integrated in order to overcome this disadvantage model. With the Permanent Magnet Synchronous Generator (PMSG) driven wind turbine, the wind power system is simulated using MATLAB.

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