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Implementation of Hybrid Wind-Solar Energy Conversion Systems

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Abstract. Along with the growing issues regarding global warming and reduction of reserves of fossil fuels, researchers all around the world are attempting to look for alternate resourced required for saving the planet for the coming future. For our requirement more and more plants are set up using the wind, hydro and solar generation of power. It is known that wind power generation owns its can provide power to some huge extent however this resource is also not predictable in terms of its presence in the atmosphere. In a similar manner power through sun cannot be dependent on, it can be present for whole day but can atmospheric conditions be never reliable and unexpected clouds, rains, trees can be factors of limitations related to such power generation. Most basic signs of climate especially in sun and wind systems are due to their irregular natures of appearance which makes there a very unreliable source of power. Although using the two resources in combination, by using algorithms such as MPPT: "Maximum Power Point Tracking", an effective transfer of power can be done to enhance the reliability and effectiveness of the power generation system.

Keywords—Solar Power, Wind Power, MPPT

1. INTRODUCTION

Implementation of Hybrid Wind-Solar Energy Conversion Systems, Solar power and wind power are considered clean, unobtrusive, limitless and environmentally friendly. Such features have attracted the potential field to utilize large-scale renewable potential sources. Although almost every renewable source of energy has it's concede limitations. Solar and wind sources depend upon factors that are unpredictable like the changing conditions of the climate or the weather.

Both sources because of their ever-changing aspects can, however, remove the issue by removing the limitation of one using other resource's power. Such an idea can give rise to the concept of "Hybrid Solar-wind power plant". Such hybrid stations of producing energy are considered as most beneficial in reducing fossil fuel depletion rates. along with being used in some small areas, with less or no power supply with no harm done to the natural environment.

The first is AC-to-AC, the second is AC-to-DC, the third is DC-to-AC, and finally, DC-to-DC. In the matter of functional description, modern power electronics fixed plan performs one or more of the following conversion functions. An optimistic outlook for renewable potential sources over the past few years so as to meet the argument of increased viability and reduce environmental issues. Renewable sources Fancy solar, wind, hydro have enough capabilities to compensate for increased demand. Commercial wind turbine generators located in wind farms are capable of generating large amounts of MW alone, but the presence of wind is a very unreliable factor because they can be very high at that point, safe operating point, especially in fancy tornadoes. , Or at times it is too low, the cut-wind required to start the windmill is less than the wind speed.

2. LITERATURE REVIEW

Micro Hybrid Power Systems - A feasibility study [1], with information of designs on wind turbine and solar PV hybrid power generation, with specific plans to power 100 homes as well as elementary school and health clinics model communities. This particular study initiated by examining the potential of wind and solar sources in the interest area.[2]

The Kyoto Protocol has established goals for participating countries to minimize greenhouse gas emissions by a minimum of five%.The 1990 amount is reduced in the commitment time via 2008 to 2012. [3] US Based on the Potency Information Administration, the planet's electric usage is going to increase through 12,833 TWh in 1999 to 22,230 TWhthroughout 2020, primarily driven by developing nations, wherever 2 billion folks continue to be with no electricity usage. [4]

Wind power prediction as well as integration into the power grid [5]. To evaluate alternatives for F-grid electrification in Bhutan Kingdom's rural villages. This study was conducted in the country's 4 distinct locations. Moreover, only communications and lighting services consider the demand load. This paper mainly emphasized on the hybrid power generating units' optimization. [6]

The wind/battery fixed plan is to be implemented in the Yangtze site. This particular session summarizes the presentation: "Digital Signal Processing for Green Power Systems and Delivery". There is a significant increase in the electrical systems that are accessed through wind power.[7]

The mini-grid category introduces multipurpose electrical power service for communities with a population of Saw to Indelible El Thousand (probably 50 to 500 homes or more). With an overall strength lead from the most extraordinary daily of the day to the vaguely aloes KWH [8]

Because of the wind power's disruptive characteristics,[9] the wind power development faces a primary issue of grid integration. The power fixed plan security and stability issues help in accomplishing the wind farms unpredictable power generation.

Table 1: Parameter analysis of different methods

Title of the research Papers	Methodology used	Disadvantage of research paper	Research gap	Advantage of my paper
Simulation of solar hybrid systems using PSIM	Integrated into PSIM software	System Integrated, small wind into PCM software the turbine is selected for maximum power to 2 kW	System Integrated into Matlab Software, a maximum 5 MW power is used for Wind Turbine.	Matlab is a fast one. Use a selection software at the system as well as circuit level. Having a private user interface. Mainly utilized in the control power converters and circuits' simulation.
Micro-hybrid power systems	Electricity is used to avail the power which is a Standalone Direct Power Inverter System	Systems are currently using Solar Energy, unable to find more work than using windows. Energy	MPPT, the sun's maxim Potential power is extracted from the system that is utilized by the Boost Converter system whenever it's available	Solar is a hybrid system Integrated into Matlab Software
Wind-Solar Hybrid Power Sy stem for Annual Applications	Electricity and Solar Resources Combine Specific Potential in Electricity Generation As a static stand-alone or grid-connected hybrid power system	During the 1.5 CW is the hot season and 1.0 kW is the rainy season	Only grid-connected MPPT controller, maximum power of 5 kW	Having a private user interface. Mainly utilized in the control power converters and circuits' simulation.
A Hybrid Wind-Solar Energy System: New Rectifier Stage Top OL Logic	Depending on tl availability frontend rec stage. two sou the OUR source	There are additional input filters Don't fill the high-freedom harmonics	High-frequency harmonics are filtered with help of extra input filters: 2) All renewable resources are up / down (huge support) wind input as well as PV Ranges) MPPT is realistic.	The High-performance DC-DC converter i is better in comparison to NeNeParent. PWM technology offers good harmonic Decrease

Village Power Hybrid Systems Development	Study Case. No Methodology Is Developed	Adv. The Developing World Will Experience Rapid Growth in The Application of Electricity_ To Meet Community Economic and Social Needs Over the Next Decade	Modelling	Village Power Hybrid Systems Development
Modelling and Control for Smart Grid Integration of Solar/Wind Energy Conversion System	synchronous (Induction) Generator, P&O Algorithm, 28.8kw Solar Power System	The PV system available power greatly depends on Solar Radiation.	A maximum of 5 MW power is used for Wind Turbine. Mppt Controller Is Used	Every source realized through Mppt. The Dc-Dc Converter Having Higher Efficiency of nearly more than 90.
Optimization of Hybrid Pv/Wind Power System for Remote Telecom	Telecommunication Networks, In Hswps Sizing and analyzing. Pragmatic Applications are found by the Proposed System.	The telecom load that is controlled by these PV systems is 750 W.	The sun's maximum possible power is extracted with the help of designed Boost Converter that uses MPPT.	Direct mode is used for work, by the Proposed Hybrid System. Also, in case the generated power by the Solar and Wind Energy is greater than load, then battery directly stores the extra power.
Optimization of A Combined Wind and Solar Power Plant	Optimized Active Areas ofa Photo Voltaic Conversion System. Battery Storage Units	Very Small Unit of Solar and Wind Different and Then Energy Is Store in Battery Then Connected in Parallel	Direct mode is used for work by the Proposed Hybrid System. Also, in case the generated power by the Solar and Wind Energy is greater than load, then battery directly stores the extra power.	The sun's maximum possible power is extracted with the help of designed Boost Converter that uses MPPT.
A Simple Sizing Algorithm for Stand-Alone Pv/Wind/Battery Hybrid Microgrid	This Algorithm Determines the Photovoltaic Array and Wind-Turbine Generator's Generating Units That Are Needed	Observation Based Algorithm. Hybrid Micro- grid is Stand-Alone	Mppt Algorithm and System Developed	Direct Grid-Connected System Using Mppt Controller and Dc to Dc Booster
Wind Energy Conversion Systems	Wind Energy Case Study	No Solar Part included Hybrid System of Wind and Solar	Modellingof Hybrid System	Wind Energy Conversion Systems

3. RESEARCH METHODOLOGY

3.1 Objectives Methodology

Renewable sources such as hydro, fancy solar as well as wind have more ability to recompense for the increased potential. Commercial wind turbine generators are basically situated in wind farms and they have the capability to produce high amount of MW. However due to wind factor as it can be very cold at times, a safe operating fact, especially in fancy tornadoes Or for a short time it is much less than the cut-wind speed required starting a windmill. This is the main reason for solar power. Throughout the day it is present in scattered form, but the level of irradiation changes based on natural situations like shadow creates by trees, objects as well as clouds and so on. And solar power makes them an incredible source of energy. How- ever, these 2 sources combined and MPPT algorithm was implemented, by this system power reliability maybe enhance. If one of the sources is not present or might be insufficient to fulfil the demands of loads, other potencies may be able to recompense power difference. MPPT regulates by Boost converter topology for PV panel.

3.2 Boundaries of methodology

Few drawbacks were found during this research period as well as assumptions were also made:

(a) In this particular research work, load application has been made as the actual capacity consumption as well as residents' income in the research work. Therefore, in order to accurate load quality data, better option is to take a survey with the power needs of the villagers.

(b) The imaginary Numis R of the houses taken is the old Najis R in the particular area, though current Numis R was considered to calculate the actual electricity load applications of society.

(c) Syndically al techniques have applied to obtain the maximum accurate cost of power specific plan installation along with components costs.

4. EXPERIMENT SIMULATIONS ON MATLAB

Table 2: Parameters for wind turbines

Wind Turbine Parameter	
Nominal Output Power	5kW
Base Wind Speed	12 m/s
Base Rotational Speed	10m/s
Initial Rotational Speed	0.8 rpm
Moment of Inertia	1m kg.m^2
Torque Flag	0
Master/Slave Flag	1

Table 3: Parameters for the Permanent Magnet Synchronous Machine

Permanent Magnet Synchronous Machine	
Rs (stator resistance)	1m ohm
Ld (d-axis ind.)	1m H
Lq (q-axis ind.)	1mH. The d-q coordinate is defined such that the d-axis passes through the center of the magnet, and the q-axis is in the middle is tween two magnets. The q-axis is leading the d-axis
Vpk / krpm (Peak line-to-line back emf constant, in V/krpm (mechanical speed)).	7112
No. of Poles	P 30
Moment of Inertia	100m kg.m^2
Master/slave Flag	0

4.1 MATLAB / Simulink Model Implementation

The simulation model was created primarily for the opportunity analysis of the use of renewable potential equipment, for their management in the design phase, and to study the problems that might be caused by the solution adopted. The solution adopted concerns the management solutions that are adopted, but also the supervision, regulation and mandate of renewable potensiosis and the consumer.

The studies performed considered various configurations and the availability of renewable energy. The availability of renewable power sources was taken in the range of 0.8 - 3 kWh / m2 for solar source, wind speed is between 2 and 20 m / s and water flow is between 30 and 1001 / s and it varies from 50 m level. Hydro Resource. Linear and nonlinear consumers (pi = 33 kW) were also considered.

4.2 Result and Discussion

4.2.1 Discussion

Thesis load application comes from a combination of PV arrays, wind turbines and batteries. An inverter is used to convert the output from solar and wind systems to AC power output. The circuit breaker is used to connect an additional load of 5 kW in a given time. This hybrid is controlled to provide maximum output power under all operating conditions to meet a fixed plan load. Either wind or solar is supported by batteries to meet specific plan loads. Also, simultaneous operation of wind and solar specific scheme is supported by battery for uniform load.

4.2.2 PV Modules

The power output of the solar cell is given by P = V * I. For simulation, solar irradiance and wind speed are used. The data is the input of the PV and the wind potency system. PV and wind potentiating are shown as waveforms of the fixed scheme and also the grid voltage and flow waveform. Grid voltage and current are analysed by Fourier transform and both harmonics grid voltage and current are calculated.

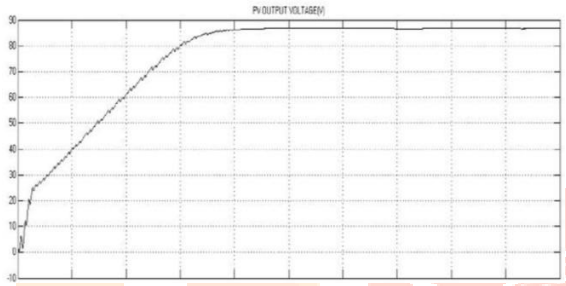

Figure 1: Output voltage of PV system

It is clear that the Earth receives maximum power from the Sun between 11:00 am and 03:00 am. The designed battery bank is 48V, 200Ah. We also considered a DOD of 50%. Thus, the total capacity to charge 5000 drained batteries is 4800Wh. For ease of design, let's assume that the power of the sun is available for at least 10 hours a day. Thus, ideally a 480W rated solar panel can produce 4800Wh in 10 hours. But in the practical case, this does not happen because of the variations in the availability of the sun's radiation. The panel rating of 175% is on the safe side of the design. Thus, the panel rating is 480 x 1.75 = 840W. The easy options interning at 1 kW panel, considering the converter effect is 90%. This designed rating was only suitable for charging half-drained batteries at full charge.

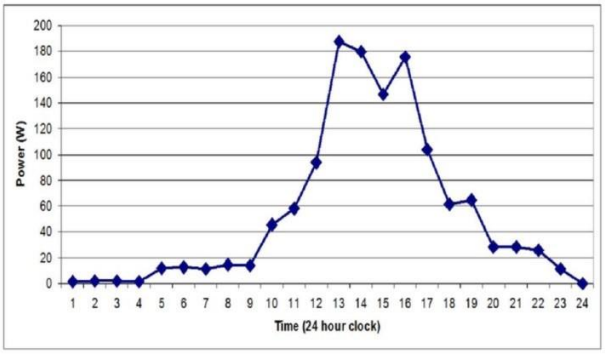

Figure 2: Availability of power per assemblage area during a day

4.2.3 Wind Modular

Setting GenModel= 3 allows users to write user-defined generator models in Fortran. Nevertheless, we have chosen to develop generator models using Simulink's more visual block diagram representation. For this purpose, we could not set VSContrl = 0 because FAST requires input from Simulink. Setting VSControl = 1 will use a fast-built, simple, variable-speed generator model: While setting VSContrl = 2 allows users to write their own variable-speed generator model in a Fortran. None of these options was applicable. Setting VSControl= 3 allows input from Simlink .

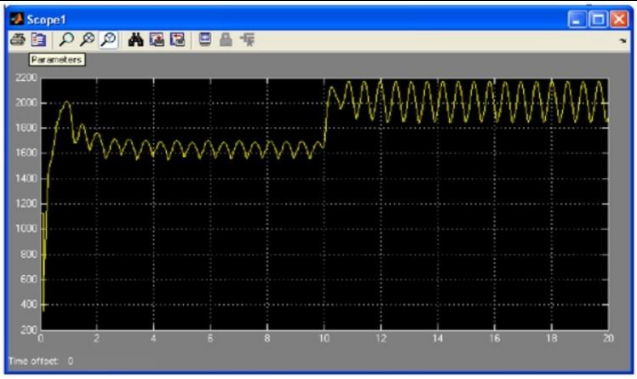

Figure 3: Example of a MATLAB scope output during run time

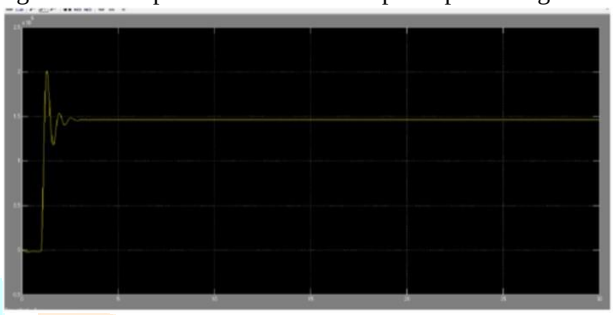

Figure 4: Completion of wind power plant in Matlab

The results show that from a significant step in wind speed, from 12 m/s to 15 m/m, HSS speed made very small (less than 1%) changes (128 rad/s to 128.5 rad/s). Hyundairably, the output torque and power showed major changes. There was no wow or pitch regulation at the venue. The oscillations in the volume were the end of the torque shadow effect, which caused by changing the ody's rhodium-torque from disturbing the tower's wind, causing the wind to flow in a downwind turbine. This model does not have the ability to convert electrical stimulation into a generator, as it was effectively connected to a fully fixed-voltage, faultproof, "infinite" bus. Thus, electrical defects and their effects cannot be pretended to the extent associated with the turbine execution.

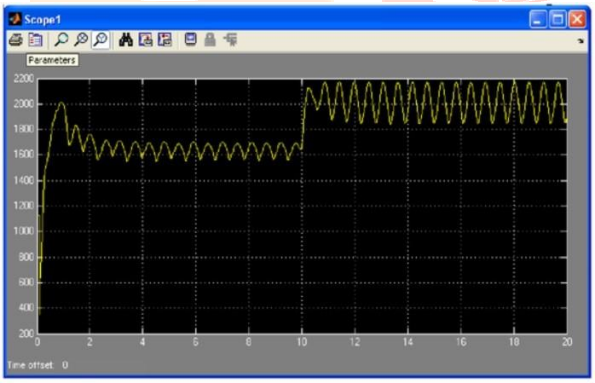

Figure 5: Example of a MATLAB scope output during run time

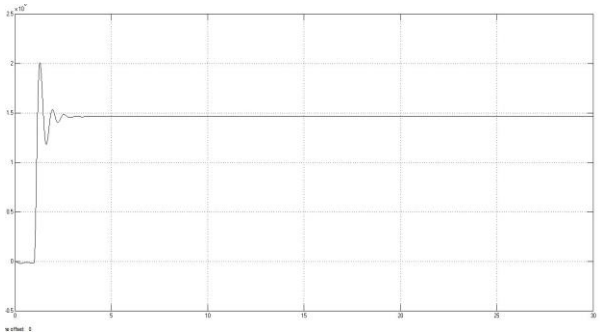

Figure 6: Completion of wind power plant in Matlab

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The physical diagram and power-speed characteristic of the type 3 WTG is shown in Figure (a) and Figure (b). which shows some results from the simulation of the single-phase sag. Figure (a) shows the torque, speed and power on the high-speed shaft. This signal causes the fault to be about 2.5-Hz oscillations that last long after the fault is cleared, indicating that some mechanical oscillations in the drive were fancy excited.

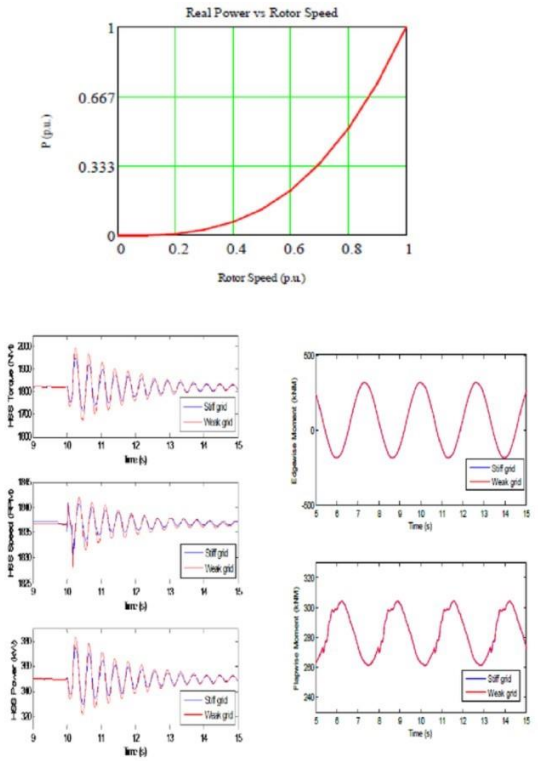

Figure 7: Simulation results showing the impact of a single-phase voltage sag for a Type 3 WTG on (a) high-speed shaft torque, speed, and power and (b) edgewise and flap wise blade moments at the blade root.

4.2.4 Three-phase regulatory rectifiers

Three phase regulated rectifiers were completed using the MATLAB Simulation. The results of the simulation are as follows. The rectifier diagram shows the output waveform of a three-phase regulated rectifier, a pulse generator of six IGBTs, a model file in the MATABL Simulink, respectively.

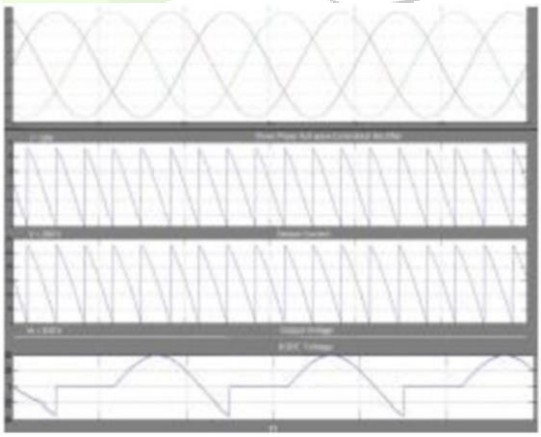

Figure 8: Output Waveform of Three phase Full Wave regulated

rectifier with R load

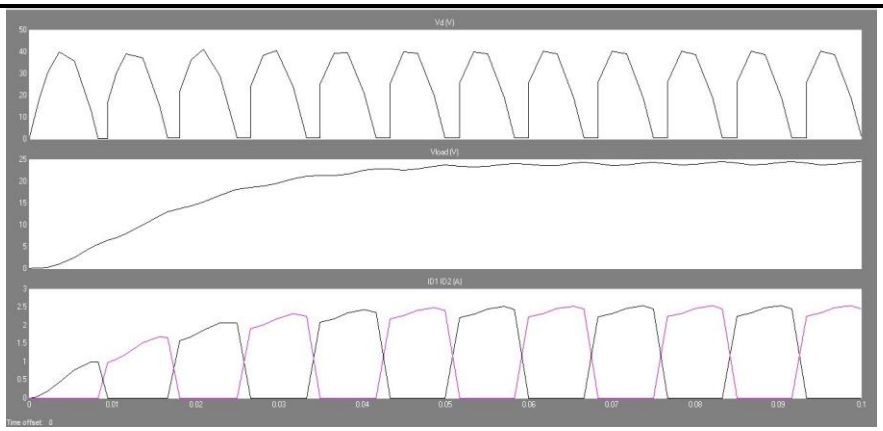

Figure 9: Result of rectifier

5. Buck Boost Convener

The plot shows a lower output voltage compared to the reference voltage. It shows the changing load current and the power of the PWM cycle average of the two MOSFETs.

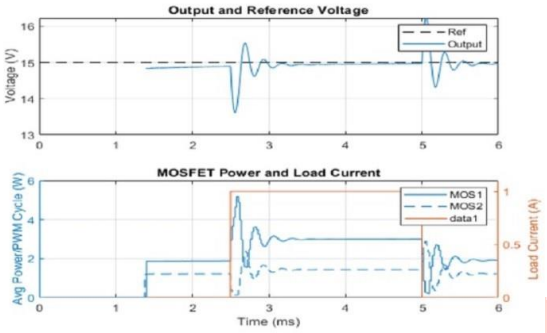

Figure 10: The plots is show the of the different implementations of the PI Regulator

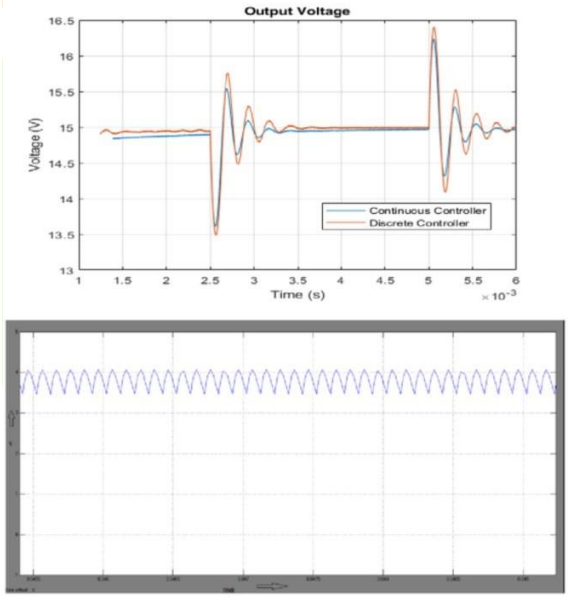

Figure 11: Simulation completion of DC-DC converter (Voltage Vs. Time)

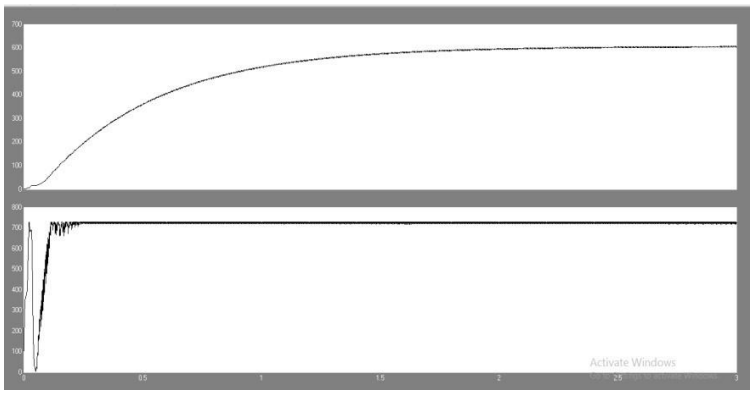

Figure 12: Completion of buck-boost converter

6. Wind Power MPPT

Time Simulation The hybrid power is carried out for a specific scheme with constant load under sufficient wind and senses. Turbine output power characteristics and wind power output characteristics are analyzed.

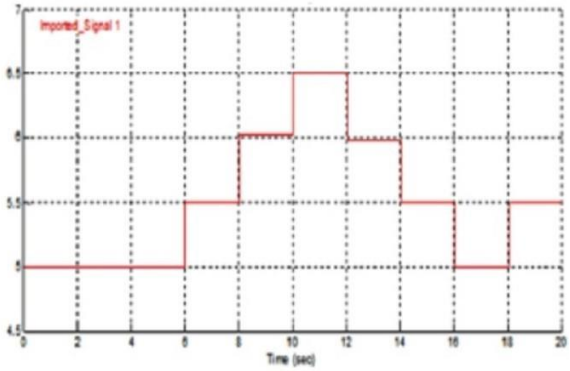

Figure 13: Wind velocity variation

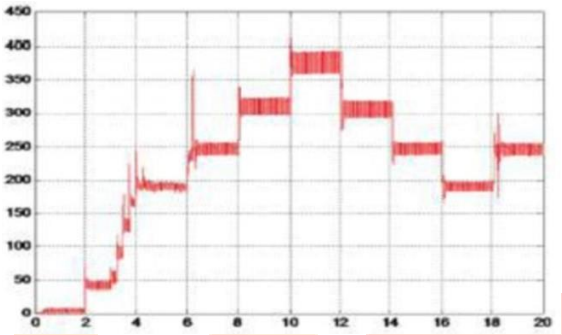

Figure 14: Power Variation with change in wind velocity

The consultation algorithm is tested under different conditions of the rapidly changing wind speed as shown in Fig. Wind turbines find the maximum power point of the wind speed. The reference input regulator MPPT algorithm was developed accordingly to track current injector. An effective tracking feature of the consultant MPPT algorithm, separated by power characteristics, as shown in Fig.

The power coefficient of the particular scheme shown in Fig. By observing the CP, the change in wind capacity proves the maximum power point tracking capacity of the fixed plan. This completion proves the work of the wind potency conversion fixed plan at maximum power point.

7 Grid Connected Hybrid System

The p-v characteristics of the solar cell taken for the purpose of simulation. DC-DC Boost Converter Topology is used for stutter performance. Boost converter topology is also used in additional carrying method for high efficiency. An LC filter is added at the end of the boost stage to remove the high frequency ripple from the output voltage waveform.

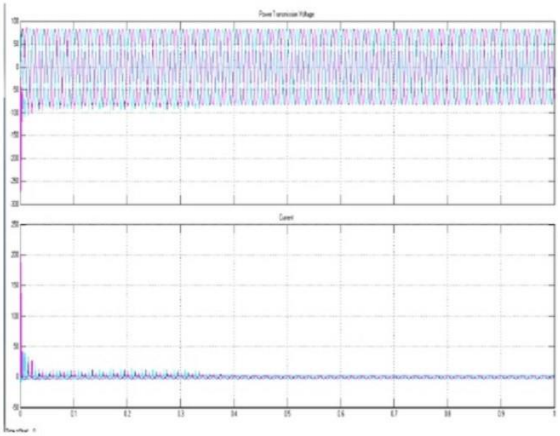

Figure 15: Completion of the hybrid specific scheme shown in the Simulink above

Wind velocity is not so high, but sufficient to generate electric power, so the first and important step is to increase the swell area. One priority area is 3.5m2. In addition, the power engender by considering the istz limit is shown in the figure. Taking a turbine's cut-in speed of 3.5 m / s, it is clear from the figure that a total power of more than 1 kW (assuming the generator effects are at least 90%) can ignite the wind during the daytime.

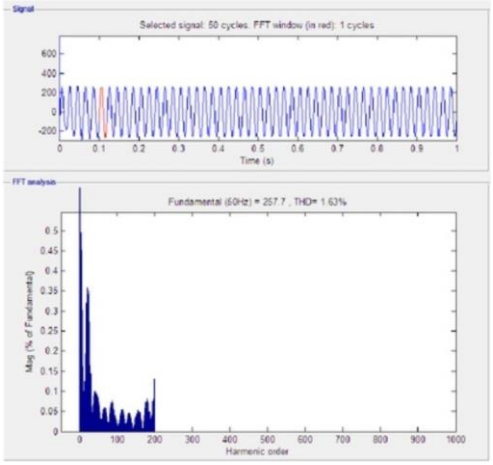

Figure 16: Harmonic analysis of grid voltage of Hybrid Power S) stem

As the wind potentials are aerodynamically comparable to solar energy, we will reduce the capacity of the solar panel connected to the circuit. The radiation of the sun as it approaches the project site is a variable amount. The specific incident strength of the assemblageria against the time of day is shown in Fig. The design rating of the 1 kW panel is shown in the figure.

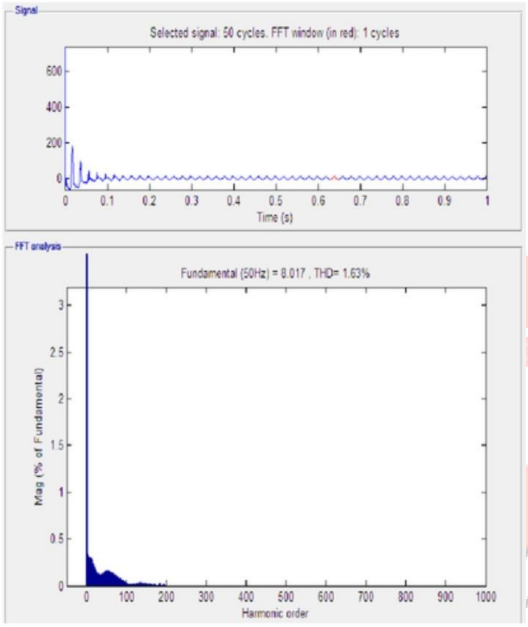

Figure 17: Harmonic analysis of grid Current

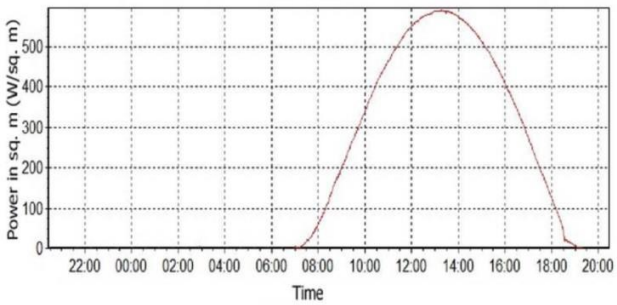

Figure 18: Hourly average wind powers harnessed during the July 2018

8. Conclusion and Future Scope

8.1 Conclusion

A novel PV / WT hybrid power fixed plan has been designed and modelled for smart grid applications. The co-schemes of the developed algorithm make certain plan components and appropriate power flow regulators. This model has been implemented using the MATLAB / SIMLINK software package, and has been designed with the dialogue buffs used in the Simlink block chain libraries.

The Power Fixed Planners (MATABL / Simlink) for an approach to the design and analysis of wind turbines, both in terms of how the turbine affects the grid and how the grid affects the turbine.

8.2 Discussions

Modelling of solar-wind-hydroelectric hybrid fixed scheme in the Simlink environment. The application is useful for analyzing and simulating the actual hybrid solar-wind-hydroelectric precision scheme connected to the public grid. Each component is built on an application modular architecture for easy study of module performance. Blocks fancy wind model, solar model, hydroelectric model, potency conversion and load are applied and the results of the simulation are also presented. For example, one of the most important studies is the existence of a hybrid fixed scheme that allows to employ renewable and variable time potassiors while providing continuous supply. The application also represents a useful tool in research activity and education.

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