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# REVIEW OF HYBRID CONTROLLER TO SELECT THE BEST OPTIMAL POWER FLOW IN HYBRID POWER STATION

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**ABSTRACT**

In this paper a review of continuous mode Hybrid power station with battery and Diesel generator (DG) is studied. The main objective of paper is to select best optimal power flow in hybrid power station to design a controller for hybrid system. The performance of the controller designed is compared in this paper and best controller is selected to increase the usage of renewable energy sources for commercial and residential loads.
**Keywords**
HPS, DG, PV, Hybrid Controller

## INTRODUCTION

World energy consumption has been on the rise worldwide as developing nations begin to industrialize and as consumers in developed nations buy more energy consuming appliances to make life more comfortable. If the current trends continue, we may face an energy shortage in future. All the energy on earth is derived from the sun .However, it occurs in various forms that today, man has developed the technology to exploit and use for agricultural, industrial and personal advancement. Energy used to power our lives can be divided into two types: Renewable and Non-renewable.Renewable sources are those sources that are continuously replenished by the action of the sun on the earth. Theyinclude wind, hydro-power, solar, bio-fuels and geothermal. Non-renewable sources are usually fossil fuels whosesupplies will one day run out. An exception is Nuclear power which, though a non-renewable, is not produced from afossil fuel.

This paper proposes, the power flow management for Grid Connected Photovoltaic/Wind turbine/ Diesel generator with the forces on optimal scheduling. This hybrid system include PV panels wind turbine, diesel generator and battery bank etc. wind and solar power are the two most widely used renewable sources of energy among all renewable sources solar panels and wind turbine are the main energy sources and the Battery Bank are the backup energy source for the system. The Hybrid system will focus to use of solar energy and wind energy as a Hybrid source, the Hybrid source has to be enough to support the AC loads and DC loads. If the energy is not enough, the system will start the Battery bank (or) the diesel generators automatically.

### Hybrid System Model and Block Diagram

Hybrid power plant consists of mainly the solar cells, wind & DG. The energy is produced from the combination and is fed to the load via hybrid controller; the function of hybrid controller is to allow the energy sources to supply the load separately or simultaneously depending on the availability of the energy sources. Fig 1 shows the block diagram of hybrid power station consisting of solar wind and diesel generator. A hybrid controller is used to manage the optimal power flow in the system.[1]

### Review of Controllers for Hybrid Power Station

Hybrid power generation is a hot topic in renewable engineering systems. Many people have worked in this filed. Below is a summary of the most relevant work in the literature.

In (Trazouei, 2013), optimal design of a hybrid solar-wind-diesel power system to electrify rural areas using imperialist competitive algorithm was designed. Some artificial intelligence optimization techniques were presented

as well. The ultimate goal was to minimize the net cost of the hybrid system for 20 years. The imperialist competitive algorithm was shown to be the fastest and the most accurate.
In (Oğuz, 2012), isolated wind-photovoltaic hybrid power system with battery storage was presented and supposed to be able to supply electricity to two laboratories with a peak electrical load of 1072 W. Statistical comparisons were performed to compare between the energy generated and the energy consumed. Monthly data were obtained and compared, and as a result of the comparison, it was shown that the generated power was above the consumed power.

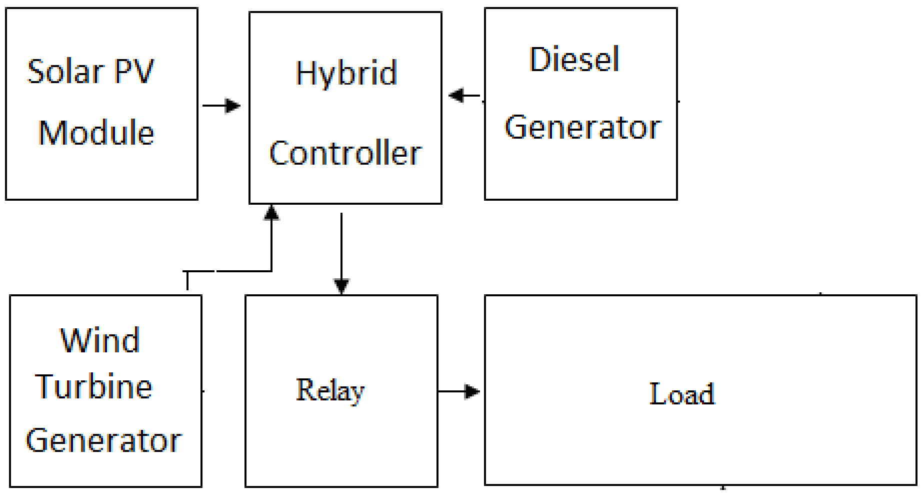


**Figure 1- Block diagram of hybrid Power Station**

In (Godson, 2013), a Solar-Wind hybrid power system was presented. The system was controlled based on micro controller. This assures optimum resource utilization and efficiency improvement as compared with their individual mode of generation. It also makes the system more reliable and dependable.
In (Salmani, 2014), several hybrid energy system models were analyzed. HOMER software was used to evaluate the systems and a remote island was taken into consideration to study the most cost effective configuration.
In (Rashidi, 2012), the focus was on the optimal design of a solar-hydrogen hybrid based standalone system. The main goal was to achieve a minimum cost during 20 years system life. Two different configurations for fuel cell and photovoltaic hybrid system were considered. The two configurations were studied and optimized using Fuzzy Particle Swarm Optimization Algorithm where the main target was the efficiency and the cost.
In (Anayochukwu, 2013), the hybridization of diesel generator source system with renewable energy sources was explored and demonstrated. Results showed the possibility of renewable energy to substitute diesel as a source of power. This hybridization idea came to reduce the operation cost and air pollution.
In (Shivrath, 2012), a solar and wind hybrid system was optimally designed for a remotely drip irrigation system. Cost optimization of the wind-solar hybrid system was taken into consideration to provide functional guidelines for the manufacturers of small scale wind-solar hybrid systems.
In (Anagreh, 2013), the feasibility analysis of renewable energy supply options electrifying a small hotel was presented. The paper investigated both technical and economical aspects. The paper showed that on-grid small wind turbine scheme was the most realistic supply option. The paper also showed that the Net Present Cost (NPC) of grid-connected wind energy scheme decreases when the carbon tax increases. The paper concluded that the implementation of the wind and hybrid wind/solar energy resources will increase in the future.
In (Khare, 2013), a methodology for calculating the sizing and optimizing a stand-alone SPV/diesel/battery hybrid system was developed. The methodology used particle swarm optimization algorithm to minimize the system cost. The work is applicable in the cases where reliable hybrid SPV/diesel system for small railway station is required.
In (Fahmy, 2012), the goal was to design an optimal economic renewable energy system. The paper presented four systems namely: Photovoltaic-wind hybrid system, stand-alone photovoltaic system, stand-alone wind system and Photovoltaic -wind-fuel cell hybrid system. The paper showed that the Photovoltaic-wind hybrid system is more suitable than the other systems.

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In this paper we present a case study of the economic feasibility of using a hybrid renewable energy system to supply electric power to loads in remote areas and compare it with a conventional system. We consider a hybrid system consisting of a photovoltaic panels, batteries, wind turbine and diesel generator to provide richness for the electrical loads at a rate of 55 kW hours/day with 5.9 kW peak load throughout the day (24 hours). We adopted real data for the site which is a health center at Umm Jamal / Mafraq - Jordan. We performed a technical and economical analysis using the HOMER software (Laboratory N, 2014) which is a computer optimization model developed by the U.S. National Renewable Energy Laboratory (NREL). It is used to assist in the design of micro-power systems and to facilitate the comparison of power generation technologies across a wide range of applications. It can model the physical behavior of a power system and its total cost, which is the cost of installing and operating the system. It should be noted that HOMER allows the modeler to compare many different design options based on their technical and economic merits. It also assists in understanding and quantifying the effects of uncertainty or changes in the inputs to secure the power supply to the load, compare different options, and select the optimum design. The capacity of the system components are determined so as to achieve the best reliability of the system with a flow of electrical energy that is secure, continuous, and low price (Laboratory N, 2014).

**Controller Adopted For Optimal Power Flow**

The disadvantage while dealing with the implementation of a hybrid system is the uncertainties of the resource availability. So a control mechanism should be provided for ensure reliability. Even if the output from a source is unavailable or is insufficient to meet the demand, other sources should complement it so that the user will get uninterrupted power. The Algorithm based on which the control mechanism is designed is given below in Table 1.

**Table-1- Proposed operating modes**

| Solar | Wind | Grid | Modes |
|---|---|---|---|
| ON | OFF | ON | PV |
| OFF | ON | ON | Wind |
| ON | ON | ON | PV and wind |
| OFF | OFF | ON | Grid |

If the solar and grid power is available together the battery is charged from the solar power. Similarly if wind and grid power is available, the wind power is used to drive the load. When all three sources that is solar, wind and grid power is available output from both solar and wind are taken together to avoid the wastage. When none of the renewable sources are active, the grid power is utilized. In this scheme we can eliminate wastage and ensure minimum consumption of energy from the grid source.

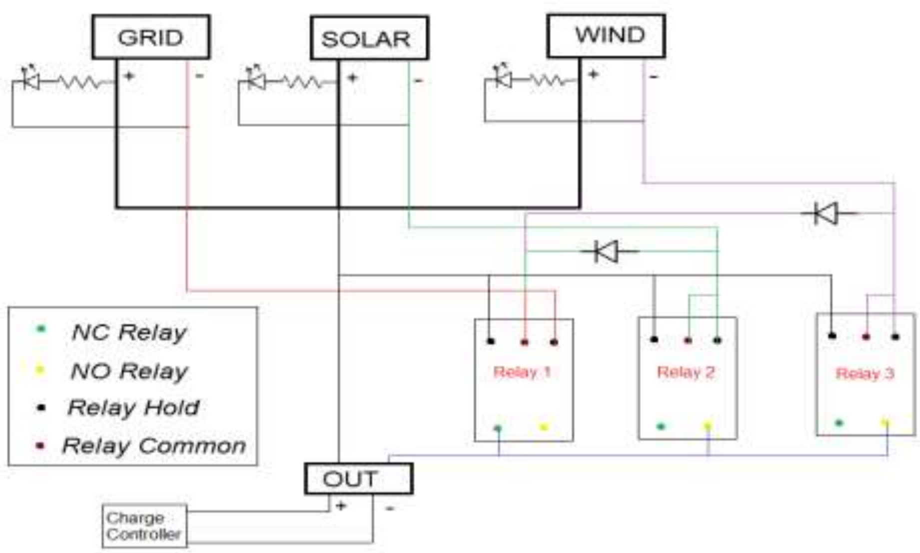


**Figure 2- Relay based hybrid controller circuit**

**CONCLUSION**

The control circuit is designed on the basis of literature review. The proposed relay based controller using 12V relays as we fixed our bus bar voltage to be 12V. Diodes are connected across the relays to provide control. The two diodes connected relay 1 and relay 2 and relay1 and relay 3 ensures that relay 1 is inoperative when either relay 2 or relay 3 or both is operating. That is the grid power is switched off when any of the renewable source is available. When both wind and solar is available, relay 3 and relay 2 are both operating and the battery is charged from both sources. Grid power is only active when no other option is available. Three LED's are connected each across solar, wind and grid power output. These are provided as the indicators to identify which incoming source is available at a definite period. An LED is also given to the output side indicating the flow of power from the control circuitry to the charge controller and there by charging the battery.

**REFERENCE**

[1] Arpan Dwivedi & Yogesh Phariya. Design and Analysis of 1.4 MW Hybrid Saps System for Rural Electrification in Off-Grid Applications, International Journal of Energy and Power Engineering Vol:11, No:11, 2017

[2] Anagreh Y., & Al-Ghzawi, A. (2013). Feasibility of utilizing renewable energy systems For a small hotel in Ajloun city, Jordan. Applied Energy, 103, 25-31.

[3] Anagreh Y., &Bataineh, A. (2011). Renewable energy potential assessment in Jordan. Renewable and Sustainable Energy Reviews, 15, 2232-2239.

[4]Anayochukwu, A. V., &Ndubueze, N. A. (2013). Potentials of Optimized Hybrid System In Powering Off-Grid Macro Base Transmitter Station Site. International Journal of renewable energy research, 3(4), 861-871.

[5]Angelopoulos, K. (Glasgow 2004). Integration of Distributed Generation in Low Voltage Networks. Power Quality in Energy Systems and Environment. M.Sc. in Energy System and Environment.

[6]Dunlop, J. P. (2010). Photovoltaic systems (2nd ed.). Illinois: American Technical Publishers Inc.

[7]Fahmy, F. H., Ahmed, N. M., &Farghally, H. M. (2012). Optimization of Renewable Energy Power System for Small Scale Brackish Reverse Osmosis Desalination Unit and a Tourism Motel in Egypt. Smart Grid and Renewable Energy, 3, 43-50. http://dx.doi.org/10.4236/sgre.2012.31006

[8]Farret, F., &Simoes, M. (Inc. IEEE PRESS, 2006). Integration of Alternative Sources of Energy. New Jersey: John Wiley and Sons.

[9]Godson, J., Karthick, M., Muthukrishnan, T., &Sivagamasundari, M. S. (2013). Solar, PV Wind ,Hybrid Power Generation System. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2(11), 5350-5354.

[10]Khare, A., &Rangnekar, S. (2013). Optimal Sizing an SPV/Diesel/Battery Hybrid System for a Remote Railway Station in India. International journal of renewable Energy research, 3(3), 673-681.