HYBRID POWER GENERATION USING SOLAR, WIND AND HYDRO ENERGY

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Abstract - *after all the increase in demand for electricity these days require more power generation which cannot be able to produce by conventional energy sources due to environmental conditions and depletion of fossil fuels. To overcome this, we have to switch from conventional to non-conventional energy resources. In our project, the combination of three renewable energy sources takes place i.e. wind, solar and hydro energy which never have been used by anyone to generate hybrid power using this sources simultaneously. This process gives the enduring energy resources without damaging the nature. We can give sustained power by using hybrid energy system. We have made the integration of three energy system which will give a regular powers supply. Vertical wind turbine utilized to convert wind energy into electricity. Solar panel is utilized to transform solar radiation into electricity. Hydro generator is used to convert hydro energy into electricity. This electrical power can be deploying for residential, or commercial purposes. In this paper, we are showing that how we have combined three renewable energy sources to generate electricity continuously without harming the nature, less maintenance and at a lower cost.*

Key words: hybrid, solar, wind, hydro, electricity, power generation, non-conventional energy.

1. INTRODUCTION

Nowadays, many researchers show their attentiveness for the significance of sustainable energy, mostly it has been noticed that fossil fuels are at higher prices and has larger negative impact on environment. Non-renewable energy sources such as fossil fuels, coal, natural gases and nuclear are limited and cannot be reused. This sources of energy are very harmful to humans and species. Renewable energy sources are the source of energy which can be restored by natural processes. These cannot be exhausted easily, can be generated constantly so it can be used again and again. non-conventional energy sources are good to fulfil the increasing demand of electricity throughout the globe. There are many renewable energy resources like solar, wind, tidal, hydro, geothermal etc.

In this present paper an inclusive literature is conducted on three energy sources i.e. solar, wind and hydro. This paper will try to provide summaries of the studies conducted during setting up this system on a fabricated frame to demonstrate using hybrid power.

India is one of the countries with the enormous production of energy from renewable sources. As 2019, 35% of India's installed electricity generation capacity is from renewable sources. The country is focusing for even more pioneering target of 57% of total electricity capacity from non-conventional energy sources by 2027. According to 2027 blueprint, India aims to have 270 GW from renewable energy, 72 GW of hydroelectricity, 100 GW of solar, 60 GW of wind, 10 GW of biomass, 5 GW of small hydro.

Yearly gross electricity generation by renewable energy source in India (Gwh):

Number	source	2014-15	2015-16	2016-17	2017-18	2018-19
1	Large hydro	129244	121377	122313	126134	135040
2	Small hydro	8060	8355	7673	5056	8703
3	Solar	4600	7450	12086	25871	39268
4	Wind	28214	28604	46011	52666	62036

Mohammad hossein Ahmadi[2]discussed solar technologies are utilised to convert solar irradiation into electricity and pv systems which are suitable to small scale power generation. A.H Elbatran[3] and chiyembekzo [4] gives a review about

hydro power technologies, challenges and turbines; it is concentrating on the types and performance of the hydro power systems and the most preferable turbines which can be used. E.A.D. Kumara[] gives an overview and behaviour of vertical axis turbine were reviewed and discussed the challenges faced by a vawt.

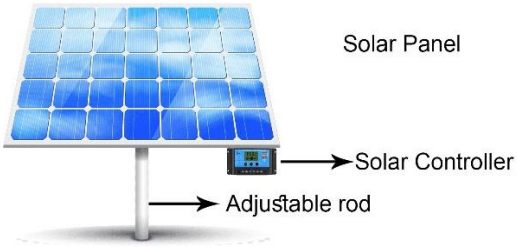
Earlier only two sources are used of hybrid power generation (solar-wind). In this we are adding one more source of energy power generation (solar-wind-hydro).

2. HYBRID ENERGY SYSTEM

The combination two or more energy sources which generates the electricity is known as hybrid power generation system. Here the system is fabricated or designed to obtain the power using three energy sources. This system has good reliability, efficiency, resources available freely, no emission, and economical. In this proposed system the use of solar, wind, and hydro for generating the power. There is no need to find special location for installing this system. We can set up hybrid energy system on to the residential apartments, or commercial place.

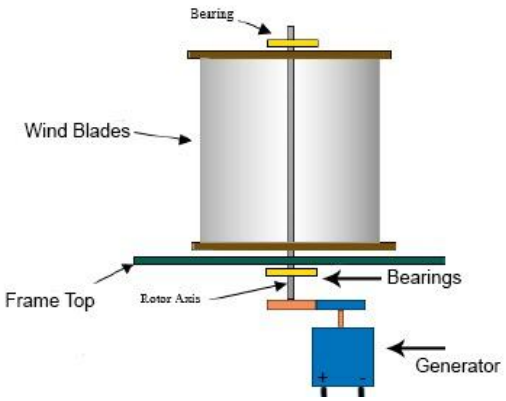
2.1 solar energy

The energy which get from the sun in the form of radiation. It is available freely and present continuously. Solar energy has high potential compare to other sources and shows greater efficiency. Solar won't be present during cloudy or night time.



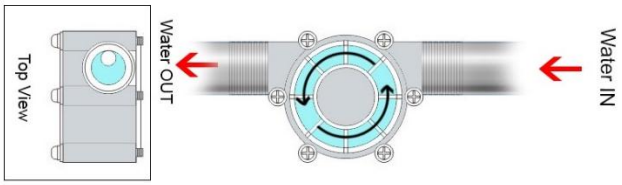
2.2 Wind energy

The energy which can be utilised from the wind to generate power. It needs low cost for generation of electricity. Wind is present almost 24 hrs on earth and can be utilised freely. It has lower emission. The speed of wind flowing depends the generation of electricity.



2.3 Hydro energy

The hydraulic energy which can be extracted from a specific amount of falling water as a result creates pressure and velocity on turbine blade surfaces thereby runs the turbine. The rotary motion of turbine can be used to generate power. Water is available freely and no emissions take place. The rate of power generation is high than other systems. It is pollution free.



Hydro-Generator 12V

FIGURE 1: HYBRID POWER GENERATION SYSTEM.

2.4 DIFFERENCE BETWEEN INDEPENDENT AND HYBRID ENERGY SYSTEM

INDEPENDENT ENERGY SYSTEM(solar or wind or hydro) 1	HYBRID ENERGY SYSTEM (solar-wind-hydro) 3
Unavailability of power all time	Availability of power all time
Generates less power per day	Generates more power per day
In this we can use only one system	In this we can use 2 or more system at a time
Efficiency is less	Efficiency is more
Life span of system is less	Life span of system is more
Requires high maintenance	Require less maintenance
If system is not working no power will be generated	If one system is not working than other system generate power as a stand by unit

3. DESIGN OF HYBRID ENERGY SYSTEM

There are several parameters involved in the design of an efficient hybrid power system. This system is constructed by taking the following specifications and materials.

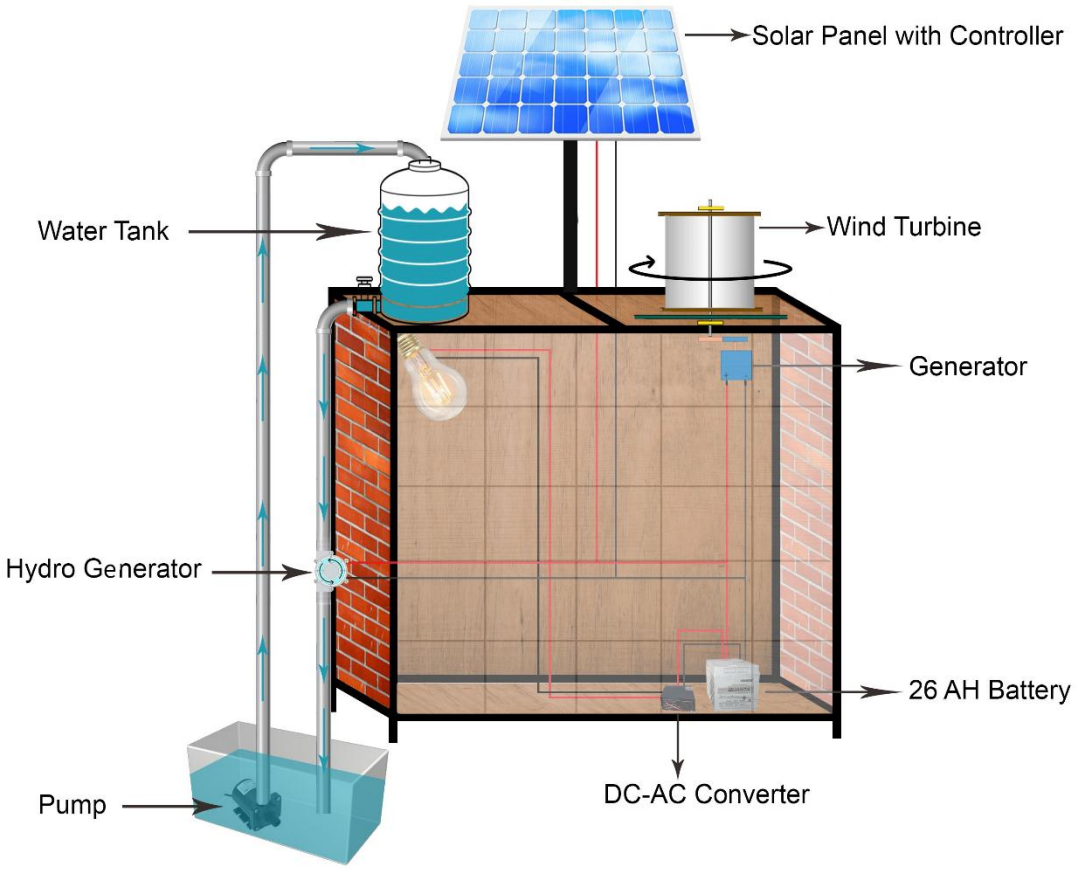


FIGURE 2: DESIGN OF HYBRID POWER GENERATION

3.1 SYSTEM COMPONENTS

3.1.1 SOLAR PANEL: solar panel used to produce electricity during day time, or during summer time it gives more results. The solar panel used in this prototype is

Output power	40 watts
Operating voltage	12volt
Panel technology	polycrystalline
Voltage at max power	19.25 volts
Current at max power	2.08 amps
Open circuit voltage	22.50volts
Short circuit current	2.22 amps

fig 3.1.1 – solar panel

3.1.2 WIND TURBINE: to produce electricity through wind we have used in this prototype of 1.5 feet height of vertical axis wind turbine

Dc Generator:

- RPM: 200 at 12

- Voltage: 4V to 12V
- Stall Shaft diameter: 6mm
- Shaft length: 22mm
- Gear assembly: Spur
- Brush type: Carbon
-
- motor weight: 143gm
- torque: 4.4Kg-cm at stall current of 1.3Amp.

Fig: 3.1.2 – dc generator

3.1.3 TURBINE BLADES AND SHAFT

Shaft diameter 20 mm and length 450 mm Blades

The blades used in this prototype are not of conventional type. In this the design was attained with 6 rect-angular shapes cut out from due to flexibility of plastic a thin plastic sheet. We were able to spiral the sail from top of the shaft to the base. the height of the blades was 300mm.

fig: 3.1.3 – wind turbine

3.1.4 HYDRO GENERATOR: to generate electricity through the flow of water we have used a DC generator which converts the kinetic energy of water into rotary motion then rotation of generator which produces the electricity

12V 10W DC MICRO HYDRO GENERATOR
the maximum pressure: 0.6Mpa outlet closed
the outlet opening maximum pressure: 1.2Mpa
Start pressure: 0.05Mpa

Fig: 3.1.4 – hydro generator

3.1.5 FRAME: to assemble all 3 sources of energy systems into one prototype we have designed and fabricated a frame work of mild steel material of size

Hallow square pipe cross section 1" square M.S
Height 4.5 feet
Length 4 feet
Width 2.5 feet

Fig: 3.1.5 – fabricated frame

3.1.6 CHARGE_CONTROLLER: charge controller has basic function that controls the source which is to be active or inactive. It also charges battery and gives power to load simultaneously. And when power is not generating it should extract power from battery and give it to the load

Fig: 3.1.6 – charge controller

3.1.7 AC-DC_CONVERTOR: this ac-dc convertor is used to convert the dc power into ac power. From this prototype we get dc power and the load require ac supply so to convert it we require ac dc convertor. This convertor does not produce any power. The power is provided by dc source only.

Fig: 3.1.7- ac-dc convertor

3.1.8 WATER TANK: to store the water and release whenever it is required we need a storage tank. We have used 20 litres water tank for this prototype. We have placed it on the top of the frame

3.1.9 BATTERY: we have chosen the battery bank size as per the requirement of the load of this prototype need (26 AH, 12V). To calculate the battery size, we need to find the following data

1. find total daily use in watt-hour (wh)
2. find the total backup time of the battery

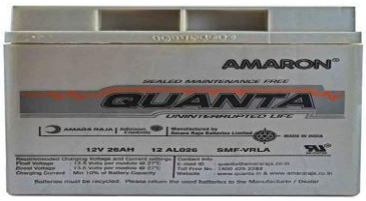


fig: 3.1.9 - battery

3.1.10 DC WATER PUMP: to pump the water to the water tank from the outlet of generator we have used 12v dc water pump. Its exit pressure is 300 lit/hr.

Fig: 3.1.10 – dc water pump

4. PROPOSED CALCULATIONS

The total power generation by this system is given as the addition of power generated by the solar panel, wind turbine and hydro generator.

Mathematically it can be represented as,

$$P_t=N_s*P_s+N_w*P_w+N_h*P_h$$

Where,

P_t is the total power generated

P_s is the power generated by solar panel

P_w is the power generated by wind turbine

P_h is the power generated by hydro generator

N_s is the no of solar panel used

N_w is the no of wind turbines used

N_h is the no of hydro generators used

4.1 CALCULATIONS OF SOLAR ENERGY

the power generated by the solar panel is determine the size of PV modules, the required energy consumption must be estimated. Therefore, power is calculated as

$$P_S = Ins(t) * A_s * Eff(pv)$$

Where,

Ins(t) is isolation time t (kw/m^2)

A_s is area of single pv panel (m^2)

Eff(pv) is overall efficiency of the pv panels and dc/dc convertors

Overall efficiency is given by,

$$Eff(pv) = H * PR$$

Where,

H = annual average solar radiation on tilted panels

PR = performance ratio, coefficient for losses.

4.2 CALCULATIONS OF WIND ENERGY

The power generated by the wind energy is given as,

$$P_w = 1/2\rho(A_w)(V)^3$$

Where,

P is power in watts (w)

ρ is the air density in kilograms per cubic meter (kg/m^2)

A_w is the swept area by air in square meters (m^2)

V is the wind speed in meters per second (m/s).

4.3 CALCULATIONS OF HYDRO ENERGY

The power generated by hydro energy is given as,

$$P_h = m * g * H * \eta$$

Where,

m is mass flow rate of water

g is gravity (9.81) m/s

H is the head from water tank to generator 1.5m

η is efficiency of generator 80%

5. FUTURE SCOPE

This hybrid power generation system can be used in various places such as homes, highways, hotels, apartments, offices, showrooms, factories etc., it is very efficient and a practical approach. By using this system, the utility cost can be minimized. This gives a clean power generation compare to other non-renewable energy sources. Its initial cost is high but can generate power at low cost and it has over 50years life span of components. It takes less maintenance mas no moving parts such as compressors. This system emits no gases or produce harmful wastes which is better for our environment. By using this systems, less shortage of fossil fuels occurs and it is economical.

6. CONCLUSIONS

The concept of hybrid power generation by using solar, wind and hydro is successfully working. Comparing this system with single or any dual power generation system this hybrid power generation has large capacity and gives more output than other systems. It is a good and effective solution for power generation than conventional energy sources. This system will reduce transmission losses and cost because it is present near to the load.

This system efficiency is improved when there is high speed of wind and high velocity of water. Whenever there are more sun radiations then the system efficiency is peaked high. People should motivate and obtain using this non-conventional energy resources. It does not produce any harmful waste like conventional energy and it is eco-friendly. It is good, reliable and affordable solution for electricity generation.

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