Hybrid Renewal Energy System for Phase Wise Direction Sources

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Abstract—**Electricity uses a hybrid of non-traditional energy sources including solar, wind, and piezoelectric. Each of the three energy sources has benefits that are used in this situation to provide power even in unfavorable environmental conditions. By combining these three sources, a dependable hybrid energy system was created, one in which all three sources could function normally and at least one remained active under abnormal circumstances. For the electrification of rural areas, this system can be helpful in a Hybrid renewal energy system for Phase wise direction sources with the help of MATLAB simulation**

Keywords—Wind Power, Solar PV Cell, Piezoelectric generator, MPSS, WPSS

I. INTRODUCTION

To meet the significant rise in electrical energy demand and address the pollution issues brought on by the use of fossil fuels, the integration of renewable energy sources (RESs) into electrical systems has become a crucial and critical issue. Electricity is produced using a variety of RESs, such as wind, photovoltaic (PV), fuel cells, and biomass [1]. Depending on the need for electric power, these principles can be used alone or together, Electricity is generated by Wind power using rotating vertical axis wind turbines, solar panels, and hybrid energy harvesting using piezoelectric materials. The rotational force created by wind turbines produces electricity, the solar panel approach, the idea behind this is to maximize energy while using solar panels as little as possible and integrated piezoelectric materials are positioned beneath the pavement. Piezoelectric material generates electrical energy as a result of the mechanical tension that creates electricity from the zip crystal oscillator and stores it in the battery energy storage system (BESS). This BESS also houses solar and piezoelectric energy, which drains into the battery of this electricity load. That same setup is constructed on the roofs of homes with solar panels, allowing the hybrid energy generated by these to be used to power domestic residences. This concept makes domestic residences independent of the Electricity Board's power source. This power can also be delivered for a specific distance from one place to another some distance during peak load duration. This happens when a subsequent amount of power is stored in BESS. some of the methods used in this system are as follows.

The hybrid renewable energy that combines wind power, photovoltaic power, and piezoelectricity with various phase angles. The objective quantitative and qualitative evaluation of the PSO (Particle Swarm Optimization) and WOA (Whale

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Optimization algorithm)-optimized STATCOM-PI (Static Synchronous Series Compensators-Proportional Integral) controllers.

II. GENERATING SOURCES

A. *Wind Power*

The fundamental principle of wind power is that a wind turbine rotates a vertical axis in contrast to a fan, which generates wind by using energy, and a wind turbine generates electricity by using wind. To generate power, a turbine's blades, which resemble propellers, revolve around a rotor.

Let A be the cross-sectional area of the blades and D the air density. Take into account a cylinder with volume , cross-sectional area A, and length . The quantity of air in volume V as in

$$\text{m} = \rho A x \quad \text{m} = \rho A x \dots\dots\dots\dots\dots\dots\dots\dots(1)$$

and
its kinetic energy is,.

$$K.E = \frac{1}{2}mv^2 = \frac{1}{2}\rho Axv^2 \dots\dots\dots\dots\dots\dots(2)$$

The duration of this volume's intersection with the blades is $\Delta t = x/v$. With a 100% efficiency assumption, the air delivers all of its kinetic energy to the blades. The energy produced as a result is,

$$P = \frac{K.E}{\Delta t} = \frac{\frac{1}{2}\rho Axv^2}{\Delta t} = \frac{1}{2}\rho Av^3 \dots\dots\dots\dots\dots(3)$$

B. *Solar PV Cell*

Photons, which are tiny energy particles, are the units of sunlight that travel to space. When this photon strikes the p-type portion of the semiconductor material, it excites the electron and causes it to flee from the hole. Due to the photoelectric effect, a potential difference at the p-n junction is obtained, and the electron moves from the p-type region to the n-type region, causing current to flow.

Using a photovoltaic system, the generated power is stored in BESS and further delivered to the grid, after using inverting. It requires the placement of various

parts, such as solar panels that converts photons into electric potential, and the generated power is delivered using cables.

Globally a relationship in mathematical domain

$$E = A \times r \times H \times PR \quad \text{.....................................(4)}$$

Where E for Energy (kWh), A for Total Area of the Panel (m^2), r for Solar Panel Yield (%), H for Annual Average Solar Radiation on Tilted Panels, and PR for Performance Ratio.

The output for a solar panel, or yield for a solar panel (r), can be calculated as the electrical energy (measured in kWh) for one solar panel divided by the surface area of one panel.

C. *Piezoelectric generator*

Piezoelectric generators offer numerous benefits in numerous applications and industries and are based on the idea of energy conversions. Most piezoelectric generators function on the same principles as a piezoelectric effect in terms of converting energy from one form to another. However, the use of such generators and piezoelectricity produce, it seems a little fascinating. Now let's talk about the Piezoelectric Generator.

Deemed a high-way, and the resulting generation of potential due to the number of vehicles, the volume of traffic, the speed of the vehicles, and any other factors. The two main criteria in this type of axle loading are vehicle size.

Suppose there are 3,000 automobiles on the road on average each day, 60 km/h is the standard automobile speed.

When calculated as

$$Fr = m + g + Cr \quad \text{.....................................(5)}$$

the rolling resistance force (Fr is obtained. Where g is equal to gravity and ranges from 0.03 to 0.15, Cr is the rolling friction coefficient, and m is the vehicle mass, which we'll supposed to be 1550 kg.

Fr = $1550 \times 9.8 \times 0.05 = 759.1$N.

The power required to overcome this rolling resistance is

$$Pr = Fr\ v, \quad \text{...(6)}$$

where 'v' denotes the vehicle's speed, which is 30 km/h. The loading time, t, is calculated using the piezoelectric generator length (lp) and vehicle speed (v), where Pr = 759.1 x 30 km/hr = 6,308W and t = lp/v = 0.072sec, respectively.

The integral f power over time is used to calculate the mechanical energy.

$$U_{in} = \int_0^t Pr\,dt = \int_0^{0.072} 6308\,dt = 454.1J \quad \text{.................(7)}$$

Finally, the electrical energy produced is computed as

$$UE = 0.078 \times 454.1 = 35.41J$$

In order to support the theoretical findings and illustrate the performance of several types of piezoelectric materials with various thickness-to-area ratios, experimental results are also provided. The experimental generator gives peak power output, which ranges from 7 to 28 kW with a corresponding power density of 9 to 173 kW/cm/sup 3.

III. HYBRID GENRATION

The Hybrid renewable energy uses a Wind system, Photovoltaic System and Piezo Electronics with different phase angles with MATLAB simulation. The impartial quantitative and qualitative comparison between the STATCOM-PI (Static Synchronous Series Compensators-Proportional Integral) controllers optimized by WOA (Whale Optimization algorithm) and PSO (Particle swarm Optimization), WOA shows better dynamic performance than PSO. This system has a Wind system, Solar PV cell, and Piezo Electronics with a 3-phase direction with the help of a Switched-reluctance generator.
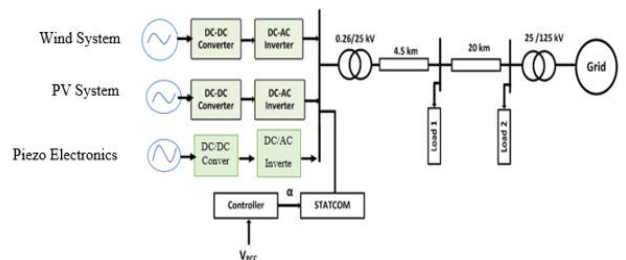

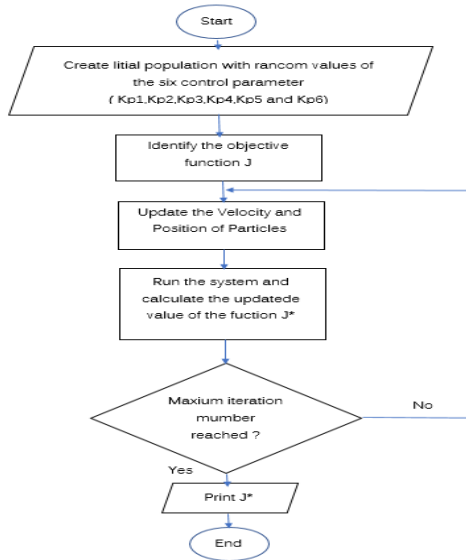*Figure 1:-Hybrid renewal energy system with 3-phase direction Model.*

Figure 2:-Hybrid renewal energy system with 3-hase detection algorithms system

Embedded suitable design for power control location in renewal energy, where in located area and genet Perfect oscillation. Calculation all the suitable sustainable renewal energy suitable stabilizing signal and all are controlled by GPSS (Global signal-based PSS). Link an appropriate control point for dampening local oscillation. A GPP system is used as a supplement for the input of a AVR along with LPS system for the damping of inter-area oscillation after the determination of the most suited stabilizing and controlled site. The transmission of power is through a tie line from region 1 to areas 2 and 3. PST completes the non-linear model's linearization (Power System Toolbox).
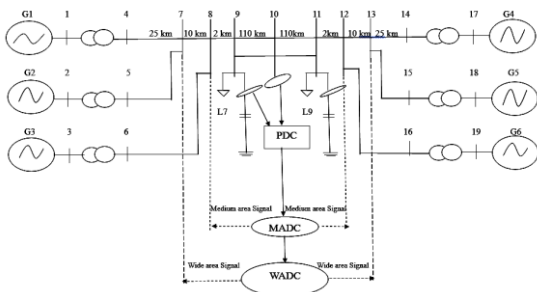

Figure 3:-The Block Diagram of Transmission system of Adaptive Linear and Non - Linear system

IV. PROPOSED SYSTEM DESCRIPTION

The investigation of inter-area oscillation used Kundur's three areas, each with two generators, an excitation system, and a governor of the ST1A type. Between buses 9-10 and 10-11, two tie lines connect these three locations. As shown in the figure 3, local rotor speed signal-based PSS are presumably connected to specific generators to dampen local oscillations and to lessen the impact of signal delay brought on by various communication channels. Global signal-based PSS are presumably connected to specific generators to dampen inter-area oscillations at specific generators (1&17),(2 &18) and (3 &19). The loads are of the constant impedance type and are coupled to buses 9 and 11. Local PSS are likely used with the chosen generator to lower the local oscillation. Also, a variety of signals from WADC

(Wide area Signal) and MADC (Medium area Signal) are received by the receivers and applied to the generator's exciter voltage reference (1& 17),(2 &18) and (3 &19). At the nominal operating point, 413 MW of power are exported through a tie line under area-1 to area-2.
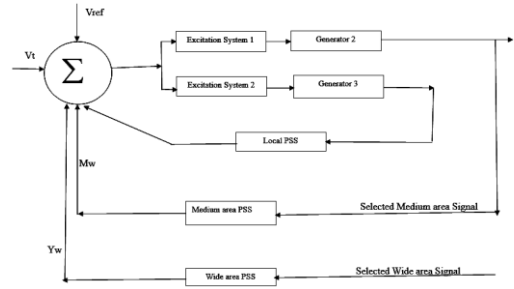

Figure 4:-Feedback system for MPSS & WPSS

A. Small Signal Analysis

Each element of Kundur's two-machine system with six machines was developed with a dynamics data sheet for small signal analysis. Model analysis was done for coherent mode identification in addition to critical mode identification, which is apparent in the section prior to this one, where one group of the generators for area-1 and another group for area-2 are oscillating in respect to one another. Each generator has 19 state variables in the developed WADC model, which is depicted in Figure 4. Therefore, the total order of the non-linear system for containing various variables for Kundur six model which is used in this study.

After linearizing the non-linear test system around the stable operating point of tie line active power, whose initial value is 413 MW, the tiny signal analysis was performed using the PST. Two key inter-area oscillation modes as a result of this are tabulated and are distinguished by their damping ratio and frequency.

V. RESULT

In Hybrid renewal energy and its phase change power system with Simulation help of Wind power system, Solar PV cell system, and piezo electronics all are connected in phase. In this proposed the long-distance AC travel easily without attenuation working properly Amplitude concerning Time.
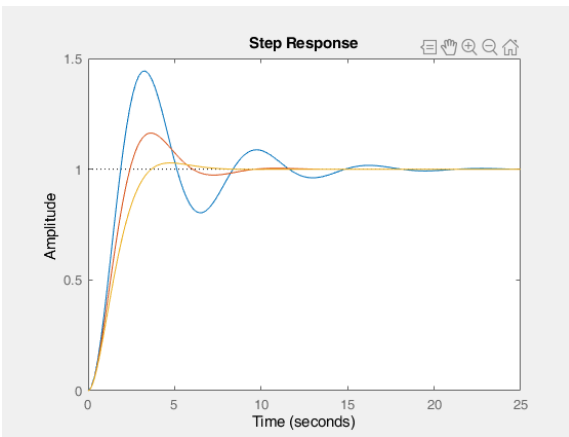
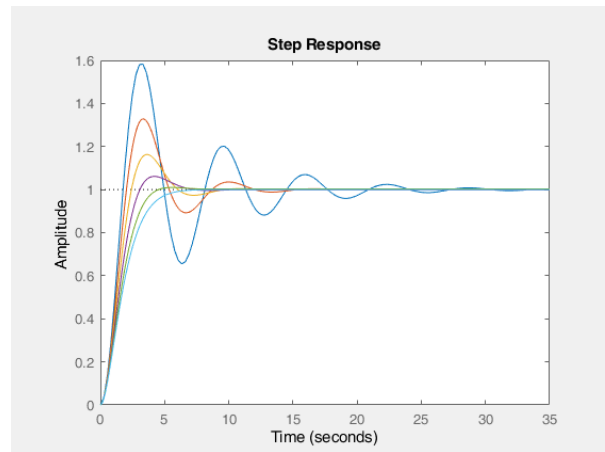*Figure 5:-Step Response for three phase system*

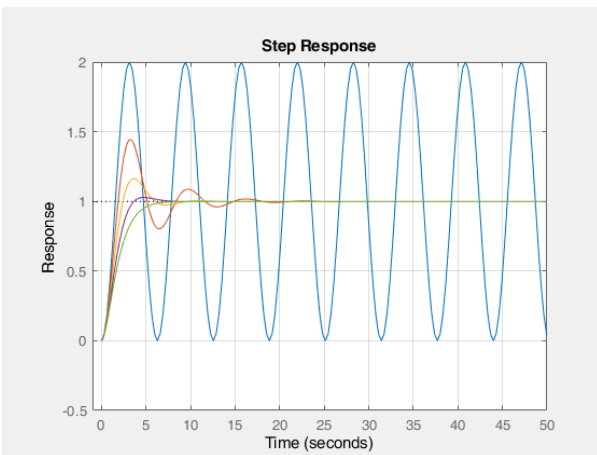In figure 6 show that where K=2 and all frequency are within the 2 response with respect to time.

Figure 6:-Step response within K=2

To generate real-valued or complex-valued tf (transfer function models) or to transform these models into tf form, this makes use of dynamic system models. Transfer functions offer a frequency-domain representation of linear time-invariant systems. while examining a continuous-time equation where the polynomials N(s) and D(s) represent the numerator and denominator, respectively. the dynamic system's transfer function, sys(s) = N(s)/D(s). Both continuous and discrete time can be used with the tf model. A model of a different type (such as a state-space model ss) can be transformed into a transfer-function form with regard to time, or the coefficients of a transfer-function model object can be directly specified.

Figure 7:-Step response for six phase with respect to time

Here, we specify the sample times of 0.25 Sec, 0.625 Sec, 0.74 Sec, 0.9 Sec, and 0.11 Sec as shown in figure 7, where the numerator and denominator coefficients, which should be ordered by decreasing the power of z. where all these step responses are within the 2 amplitude frequency.
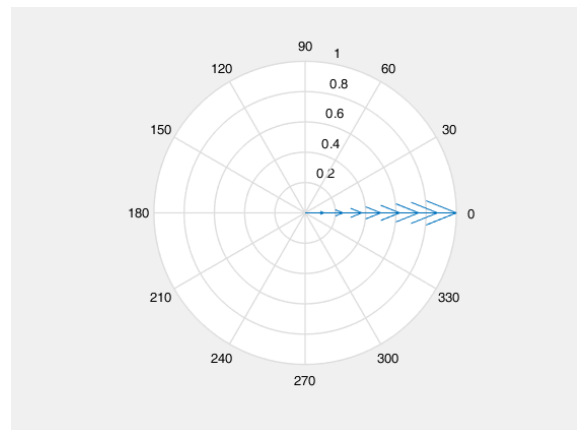

Figure 8:-Compass detection

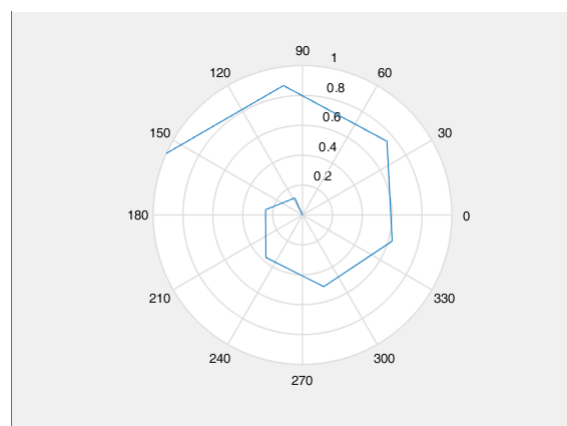In figure 8 compass direction after simulation shown all are in same direction

Figure 9:-8/6 polar scatter

Figure 8 shown 8/6 polar scatter which is withing 360 degree.

TABLE I.

Sr. No	td(Delay time/Sec)	tr(Raise time/Sec)	tp(Peak time/Sec)	mp(Peak over shoot)	ts(Settling time /Sec)
1	1.1328	1.7633	3.1863	58.7359	23.9521
2	1.3090	2.0278	3.3330	32.8499	11.9760
3	1.5588	2.4184	3.6276	16.3034	8
4	1.9590	3.0719	4.2015	6.1434	6.0241
5	3.3308	5.4454	6.4892	0.3420	4.5714
6	5.5025	9.3533	10.3693	0.0051	4.1973

In Table-1 mr(resonant frequency in rad/sec), wr(bandwidth in rad/sec), wb(bandwidth in rad/sec) & pm(phase margin in degrees

TABLE-II

Sr. No.	mr(resonant frequency in rad/sec)	wr(bandwidth in rad/sec)	wb(bandwidth in rad/sec)	pm(phase margin in degrees)
1	0.0000 - 0.3328i	0.0000 + 3.0822i	0.6800	263.2048
2	0.0000 - 0.2653i	0.0000 + 4.4159i	0.7942	264.2032
3	0.0000 - 0.2137i	0.0000 + 5.7879i	0.8506	265.0789
4	0.0000 - 0.1775i	0.0000 + 7.1764i	0.8835	265.7578
5	0.0000 - 0.1514i	0.0000 + 8.5732i	0.9047	266.2838
6	0.0000 - 0.1514i	0.0000 + 8.5732i	0.9047	266.2838

Table-2 show that, mr(resonant frequency in rad/sec), wr(bandwidth in rad/sec), wb(bandwidth in rad/sec), pm(phase margin in degrees).

In the point of view in the Table-1 & Table-2 low distortion with minimum time and fast response is obtained. The topography of the area, the potential for energy sources, and the many types of energy requirements allow for the development and optimization of hybrid energy systems to meet the needs of the locality. The most effective sizing of these hybrid systems powered by renewable generating sources can greatly enhance the technical and economic performance of the power supply and encourage the widespread use of such environmentally friendly sources. To create a hybrid renewable energy system system for phase wise direction sources that is technologically and economically optimal, various planning techniques can be used.

VI. CONCLUSION

In conclusion, each discovered sizing strategy has the potential to greatly increase the applicability of renewable energy systems system for phase wise direction sources and is therefore very significant in the field of renewable energy.

The rise in global energy demand and the environmental issues associated with the use of fossil fuels have encouraged extensive research into alternative energy sources, whether they be conventional or renewable, and these sources have now emerged as a viable answer to the problems that the world currently faces with regard to a sustainable method of supplying energy and protecting the environment.

Economical obstacles to greater adoption of renewable energy can thus be partially removed. This paper's content examines several size methodologies, including software that is currently in use and possibly alternative optimization techniques. Each sixing methodology has its own advantages, as was already said, and perhaps additional novel methodologies will prove useful in the future in this regard. Depending on the type of application, user needs, etc., the appropriate solution may not always be chosen.

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