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Online Control of Smart Grid Connected Renewable Energy Sources to Electric Vehicles

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Abstract: The usage of sustainable power source assets will fundamentally increment to accomplish perfect and economical power age. The administration of the constant development portion of variable sustainable assets, reconciliation of electric vehicles (EVs) and guideline of lattice recurrence require compelling correspondence offices of ongoing keen frameworks. In this regard, savvy converters can give productive power molding gadgets to extricate most extreme power from sustainable assets. Furthermore, the batteries of EVs could be utilized as conveyed stockpiling and release power over into the framework to remunerate control shortfall and fluctuation.

Displaying and controlling of the half and half assets inside brilliant lattice were completed in this paper. The brilliant converter is changed to follow the most extreme power point MPPT of the sun oriented boards. Likewise, the pitch edge control and DFIG guideline are utilized to extract the most extreme power under various breeze speed and tidal stream speeds. The arrangement of EVs can remunerate control vacillations and direct the recurrence deviations in the framework dependent on the proposed PID controller. In this paper, the necessary minimization of time-weighted outright mistake (ITAE) is utilized for on-line tuning of the PID controller parameters. Utilizing Matlab/Simulink bundle, the smart grid is modelled and simulated.

KEYWORDS: Solar, Wind, Tidal Energy, Electric Vehicle, Smart Grid.

I. INTRODUCTION

As of late, there is an expanding enthusiasm for introducing matrix associated inexhaustible assets, for example, wind, sunlight based and tide. This pattern is credited to monetary and specialized advantages of conveyed age DGs in savvy networks. Then again, DGs require proficient power molding converters to change their obligation cycles to acquire stable MPP under various natural conditions. It ought to be noticed that breeze and sun oriented vitality are discontinuous as well as are not really unsurprising assets. On the opposite side, tidal current is discontinuous yet effectively unsurprising and depends on a similar innovation of wind turbine. In this regard, the tidal ebb and flow speed is lower than wind speed, while the water thickness is higher than air thickness.

The vitality the executives of mixture assets is an intricate errand. During low sunlight based radiation conditions, photovoltaic (PV) board can't guarantee the required sun oriented age. So also, wind turbine won't turn until the breeze speed is equivalent to or more noteworthy than its cut-in worth. In this way, the fundamental target of intensity the board is to guarantee effective, stable framework activity and to anticipate vitality shortfall in network loads. The continuous correspondence in savvy network can encourage the age coordination and after that improve framework execution.

The specialized ecological examinations bring about viable substitution of ignition motor based autos with the electric vehicles (EVs). Through vehicle-to-Grid (V2G) innovation, the module electric vehicles (PEVs) can be utilized as vitality stockpiling batteries (SB) and can release electrical vitality back to savvy network. This implies PEVs can bolster the framework by directing its voltage and recurrence. This help depends on shrewd framework innovation to empower powerful usage of variable inexhaustible assets and electric vehicles.

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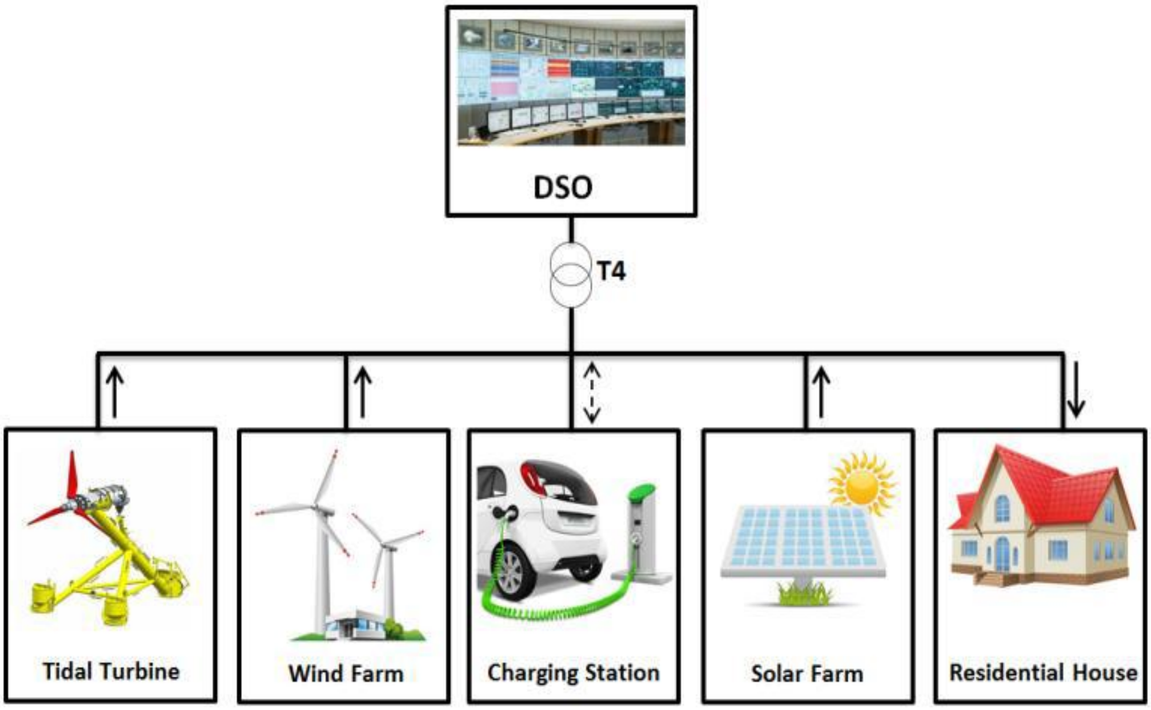
II. Modelling of Hybrid Renewable Resources

The setup of proposed half and half vitality framework is shown in Fig. (1). It comprises of seaward wind ranch, photovoltaic (PV) boards, tidal ebb and flow turbines, EVs (SB), and electric burden.

A. **Wind Turbine Modelling**



Seaward wind vitality will be a noteworthy sustainable power source. The scope of seaward wind speed variety is higher than inland speed. Variable speed turbines utilizing twofold bolstered acceptance generator (DFIG) are utilized in late wind ranches. The accessible breeze control Pw in cutting edges cleared zone (An) is given by:

$Pw = \frac{1}{2} \rho B(Vw)^3$ (1)

Where, is the density of air and Vwis the wind velocity m/s. The turbine can capture only a fraction of this wind power, which can be expressed as Pm, given by

$Pm = \frac{1}{2} \rho B(Vw)3. Cp(\sigma,\beta)$(2)

Where, Cp is the captured power coefficient. The maximum theoretical power extracted by an ideal wind turbine is limited to 59.26% of the power available in the wind. The power coefficient $Cp(\lambda,\beta)$ of equation (2) is expressed as a function of tip speed ratio σ and pitch angle β. If the wind speed continues to increase the output power will be theoretically increased until the nominal turbine power. Further wind speed increase can damage the turbine. By turbine over-speed protection, the turbine will shut down if the speed exceeds its maximum permissible value.

B. Grid connected PV systems

Generally, PV cells are grouped together in similar modules which are interconnected either in series or parallel to form the final PV array. For the most part, PV cells are assembled in comparable modules which are interconnected either in arrangement or parallel to frame the last PV exhibit. The cluster yield power is resolved through increasing condition (1) by exhibit voltage and effectiveness η. From P-V bend, there is a particular time when the created power is greatest.

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Consequently, a constant change of the cluster terminal voltage is required to extricate most extreme power (MPP) from the sun powered exhibit. The fundamental segments of the PV framework comprise of the sun powered exhibit, DC/DC keen converter. In this paper, the produced voltage of the PV board is acclimated to the appropriate level comparing to the most extreme sunlight based power utilizing P&O strategy.

C. The Model of Tidal Energy

The total kinetic power in a tidal stream is given by Pt = ½ ρCpA(*Vtide*), where ρ is the water density, Vtide is the magnitude of the tide velocity averaged over the cross section A (the turbine area). However, not all this tide power can be converted into mechanical power [3]. This limitation is related to turbine efficiency and is taken into account by the power coefficient (CP). For tide turbines, the value of Cp ranging between 0.35 and 0.5. The total mechanical power in a tidal turbine has similar features as that of a wind turbine. Consequently, the power output may be expressed as:

$$Pt = \frac{1}{2} \rho C_p A (V_{tide})^3 \quad \textbf{(3)}$$

Recently, the selected generator type for the tide energy conversion is the DFIG. The objective of the DFIG control is to generate the maximum power under different stream velocities. Therefore, the reference of the rotational speed control loop is adjusted so that the tidal turbine will operate around the maximum power according to the current tidal speed.

III. INTEGRATION OF EVS INTO SMART GRID

Most of the EV charging frameworks happen at home. Then again, the EV charging is wanted to be attempted at charging stations in broad daylight or working spots. In any case, the joining of the EVs can upgrade framework execution, and improve control quality. The cutting edge EVs are created with a bidirectional matrix interface and remote correspondence to remotely permit power stream from or to the vehicle. In this manner, a halfway aggregator must be created to facilitate the activity of the lattice and vehicles. The aggregator requires the default profiles of every single utilized Ev. These profiles are sent by every driver to the aggregator through web showing vehicle area, the condition of battery charge (SOC) and the accessibility of V2G execution. At that point relating directions are sent remotely to the vehicle for trading its electrical vitality with the network.

A.Plugged-in Electric Vehicle

The joining of EV can be considered as virtual conveyed age (VDG), where the connected vehicles are grouped and controlled as circulated vitality source. Inside this VDG idea, the dispersion framework administrator (DSO) has a remote access to the EVs through the aggregator and the put away vitality in the vehicle's batteries can take an interest in the vitality supply. The DSO and aggregator are associated over secure correspondence interface. The DSO sends guideline directions to the aggregator to designate the required guideline limit from PEVs. A schematic chart of the EV framework joining is shown in Fig.(2). Also, V2G controller is important to control the activity of the connected EVs.

In VDG activity, the recurrence blunder will be the information variable to on-line tuned PID controller to offset the age with burden and to direct the lattice recurrence. The SOC limitation of EV batteries must be considered during matrix guideline.The PID controller parameters are on-line tuned by minimizing the integral of time weighted absolute error e in grid frequency (ITAE) given by:

$$ITAE = \int t\,|e(t)|\,dt \quad \textbf{(4)}$$

The procedure for on-line parameter tuning using smart grid facilities is summarized in the following steps:

- Initialize the controller parameter
- Simulate the grid behavior and save the time series of the output absolute error |e(t)|
- Minimize the ITAE using Matlab optimization function fminsearch.
- Update the controller parameters.

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B.Storage Batteries Model

The surplus of the generated energy by hybrid resources is stored in EV's batteries, and supply this energy back to load during the period of deficit generation taking into account the batteries SOC. The SOC of the battery depends on the previous SOC and the battery energy exchange either in charging or discharging mode during Δtbetween two time instants k, k-1. In all modes of operation, the SOC is subjected to the following constraint.

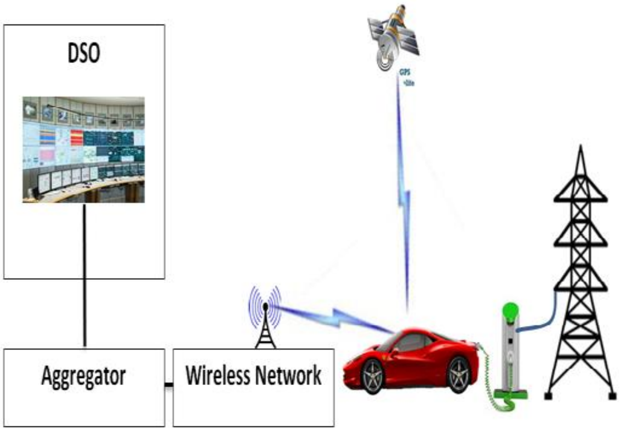

Fig. (2) Configuration of Electric-vehicle to Grid Integration

IV. LITERATURE SURVEY

The learning of the climate information are required for suitable activity of crossover sustainable assets. The factual examination of the recorded seaward wind speed demonstrates that the normal breeze speed for November, The outrageous breeze blast speed in the marine region in the scope of 25.5 m/s. Likewise, Kuwait has a wealth of sun based vitality potential. In this manner, the month to month found the middle value of sun based force on even surface region is 3.26 kWh/m2 in December and 8.16 kWh/m2 in June. The yearly normal estimation of sun based radiation arrives at 5.9 kWh/m2. In addition, the most extreme episode sun oriented radiation coordinates the pinnacle load in summer.

Generally, tidal currents correlate well with the tidal range and then the tidal current speed can be described by an approximately linear function of the range. For example, the sun riseat 5:03 h and sunset was at 18:47 h. The first low tide was at 3:35 h and the next low tide at 17:20 h. The first high tide was at 10:10 h and the next high tide will be at 23:45 h. The recorded height of maximum and minimum tide was 4.1 m and -0.3 m, respectively.
In this paper, the following three different car-user profiles are considered:

- Possible charge of 40% of EVs from charge station at work.
- No possible charge of 30% of EVs at work
- The rest of EVs with 30% are in charging/ discharging operation mode and can participate in frequency regulation of the grid.

V. SIMULATION RESULTS

Fig. (3) shows the load curve of the studied smart grid. The peak load occurs at 16:00 with a value of 20 MW, The minimum load is at mid-night with 12 MW. The maximum and minimum reactive power are 6.5 MVAR and 3.2 MVAR, respectively. To study the behavior of the system under abnormal condition a 3-phase short circuit is simulated at 8:00 for a period of 100 sec.

The generated power from PV array can be seen in Fig. (4). As indicated the generated PV power follows the daily variation in the solar radiation and the available solar power has been extracted. The participation of the PV array

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in supplying the grid load occurs during the period from 6:00 to 17:00. From this figure, it can be observed that the generated power from PV array is decreased to 60% at 15:00 due to sudden shading for 5 minutes.

In Fig. (5), variation of the power generated by the offshore wind farm is displayed and this power is high when the wind speed is higher than the cut-in speed of 4 m/s. It should be noted that the generated power from the wind farm reaches its maximum value of 4.5 MW for the interval between 21:00 and 22:00, where the wind speed is greater than the rated value of 15 m/s and less than the cut-off speed of 25 m/s. Similarly, Fig. (6) displays the generated power from the tidal plant. The maximum tidal power of 5 MW occurs at 10:00, while the generated power is very small during the period between 16:00 and 19:00 where the tide stream velocity is ranging between 0.48 and 0.74 m/s.The simulation results indicate that the proposed on-line tuned controller reduces grid frequency fluctuations.

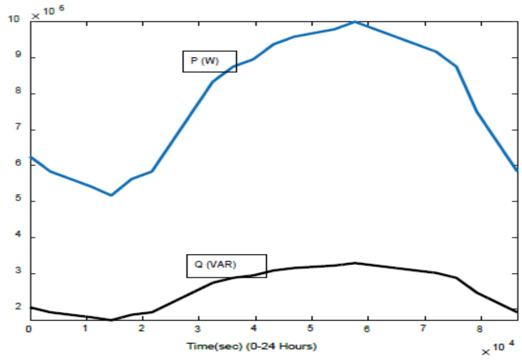

Fig. (3) Active and reactive daily load curve

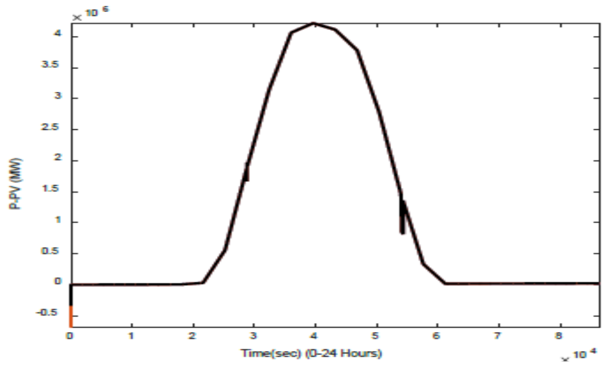

Fig. (4) Generated power from PV array

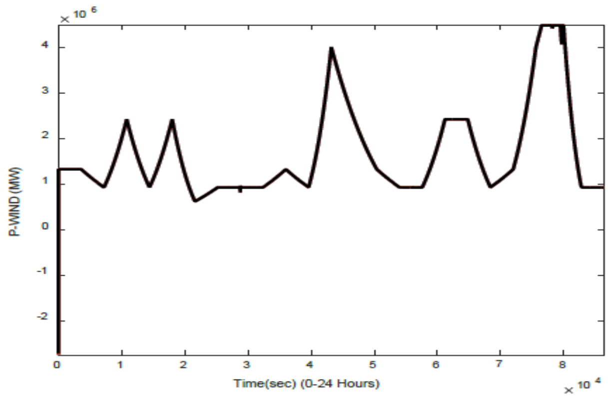

Fig. (5) Generated power from offshore wind farm

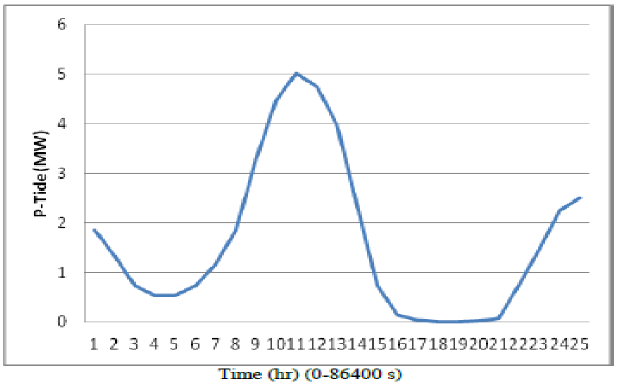

Fig (6) Generated power from tide plant

VI.CONCLUSIONS AND FUTURE RESEARCH

For effective use of half and half sustainable assets, it is important to introduce shrewd converters to separate the most extreme intensity of these assets. Matlab/simulink models have been produced for seaward wind, sunlight based and tide plants. The created power from these assets was reproduced utilizing the real recorded climate information in Kuwait. The reenactment results showed that the produced vitality was following the most extreme accessible intensity of the sustainable assets. Moreover, this paper has exhibited the connection of electric vehicles with the keen framework containing sustainable power sources. This association can give subordinate administrations to the matrix through recurrence guideline by sending of the portrayed V2G idea. This can be accomplished using propelled correspondence and on-line control procedures of savvy networks. The on-line parameters tuning calculation of the PID controller has been created to manage the network recurrence.

This parameter tuning has been accomplished by limiting the basic of time weighted supreme blunder in framework recurrence dependent on brilliant lattice offices. The advanced reenactment of the examined network has demonstrated that ITAE tuning strategy is extremely viable for taking out the recurrence blunder and decreasing its motions during framework unsettling influences. Be that as it may, money saving advantage investigation is required to legitimize future execution of the V2G in vitality showcase. In addition, further investigations are expected to create EV batteries with high vitality thickness and broadened lifetime under continuous charging and releasing cycles.

REFERENCES

[1] M. El-Sayed, S. Leeb, “Fuzzy Logic Based Maximum Power Point Tracking Using Boost Converter for Solar Photovoltaic System in Kuwait”, Renewable Energy and Power Quality Journal (RE&PQJ) ISSN 2172-038X, No. 13, April 2015.
[2] O. Mohammed, Y. Amirat, M. Benbouzid, S. Haddad, G. Feld, " Optimal sizing and energy management of hybrid wind/tidal/PV power generation system for remote areas: Application to Quessant French Island", IECON, Florence, Italy, 24-27 Oct. 2016.
[3] H. Hamed, H. Aly, M. El-Hawary. "The Current Status of Wind and Tidal in-Stream Electric Energy Resources", American Journal of Electrical Power and Energy Systems. Vol. 2, No. 2, 2013, pp. 23-40.
[4]F.Mwasilu, J. Justo, E.-K. Kim, T. Du, J.-W. Jung,"Electric vehicles and smart grid interaction: A review on vihcle to grid and renewable energy resources integration", Renewable and sustainable energy review, 34, pp. 501-516, 2014.
[5] Darabi Z, Ferdowsi M. "Aggregated impact of plug-in hybrid electric vehicles on electricity demand profile", IEEE Trans. on Sustain Energy 2011;2(4):501–8.
[6]HugoMorais, Tiago Sousa, Morten Lind, "Electric vehicle fleet management in smart grids: A review of services, optimization and control aspects", Renewable & Sustainable Energy Reviews, Vol. 56, 2016, pp. 1207–1226.
[7] Boukhezzara, B., Lupua, L.; Siguerdidjanea, H., and Hand, M., “Multivariable control strategy for variable speed, variable pitch wind turbines”, Renewable Energy, vol.32, pp.1273–1287, 2007.
[8] Weidong Xiao, William G. Dunford, Patrick R. Palmer, Antoine Capel, “Regulation of photovoltaic voltage”, IEEE Trans. on Industrial Electronics, Vol. 54, No.3, June 2007.
[9] T. Esram and P. Chapman, “Comparison of Photovoltaic array maximum power point tracking techniques,” IEEE Transactions on Energy Conversion, Vol. 22, no. 2, Jun. 2007, pp. 439-449.

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[10] S.E. Ben Elghali, M.E.H. Benbouzid and J.F. Charpentier, “Marine tidal current electric power generation technology: State of the art and current status,” Proceedings of IEEE IEMDC'07, Antalya (Turkey), vol. 2, pp. 1407-1412, May 2007.
[11] E. Sortomme , M. El-Sharkawi, "Optimal scheduling of vehicle-to-grid energy and ancillary service", IEEE Trans Smart Grid, 3(1):351–9, 2012.
[12] F. Martins, “ Tuning PID Controllers Using the ITAE Criterion”, International Journal of Engineering Education, Vol. 21, No. 3, 2005.
[13] M. Mahfouz, M. El-Sayed, "Wind Gust Protection Algorithm for Unpitched Control Wind Farm", Accepted for presentation at International Conference on Renewable Energies and Power Quality (ICREPQ’18) Salamanca (Spain), 21th to 23th March, 2018.