Educational Administration: Theory and Practice
2023, 29(4), 3460 -3469
ISSN: 2148-2403
https://kuey.net/

Research Article

Meta Heuristic Optimization Technique For Power Quality Monitoring And Feedback Control For Hybrid Renewal Energy System

Moazzam Haidari[1]*, Vivek Kumar[2]

[1*]Department of Electrical Engineering, Saharsa College of Engineering, Saharsa, Bihar 852201, India. moazzam53211@gmail.com
[2]Department of Electrical Engineering, Saharsa College of Engineering, Saharsa, Bihar 852201, India. electricalvivek@gmail.com

***Corresponding Author:-** Moazzam Haidari
*Email:-moazzam53211@gmail.com

Citation: Moazzam Haidari ,et.al, (2023), Meta Heuristic Optimization Technique For Power Quality Monitoring And Feedback Control For Hybrid Renewal Energy System , *Educational Administration: Theory and Practice, 29(4), 3460 -3469*
Doi: 10.53555/kuey.v29i4.8115

ARTICLE INFO **ABSTRACT**

The percentage of energy generated from solar and wind power is always going up, which is a positive trend. The use of Hybrid Renewable Energy Systems (H.R.E.S.), also known as HRES, in the power generation system is gaining steam. A rise in the proportion of power coming from renewable sources has led to an increase in the number of Power Quality (P.Q.) problems experienced by users and consumers. As a result of this research, electrical engineers will be able to better understand the P.Q. disturbances caused in the power system by hybrid renewable power sources, in particular solar and wind power. The research will make a prediction as to what kinds of PQ disruptions are brought about during the generation of power. The stand-alone Hybrid Renewable Energies System will serve as the primary focus of the project (H.R.E.S.). The information pertaining to the energy system will be gathered and analysed in order to develop a Grey Wolf Optimization technique for the purpose of enhancing the 3460ashington strategies in order to decrease P.Q. disruptions. The proposed method does an analysis on both the previously saved data and the ongoing data from a variety of sources. The data will be gathered, and then they will be used to drive the hardware so that the relevant measures may be taken at the mitigation level. The algorithms will make the system more efficient and will provide the designers with assistance in making the system more capable of being designed. Whenever various types of energy sources are employed to generate electricity, the surveillance system will be capable to help forecast the kinds of p.q. disturbances that are caused as a result. Such p.q. disturbances are monitored by the technology that is being suggested, and they are categorised according to the degree of their impact.

Keywords: Power Quality Monitoring, Feedback Control, Hybrid Renewable Energy Systems, Meta Heuristic Optimization Techniques.

Introduction

The capacity of a power system to provide flawless electricity without even any disruptions in the sinusoidal waveform is referred to as the power quality of the system. On the other hand, something like this would never occur in the actual world [1], [2], [3]. The sinusoidal wave that is generated by the power sources is affected by the various kinds of loads as well as other elements like the weather conditions, the different kinds of inverters, and the distances from the power source. Variations in the waveform are produced as a result of these variables, which indicate PQ disruptions. Affordable and clean electricity may be generated via the utilisation of renewable sources of energy. The idea that renewable energy power systems may function either independently or as an integral element of the distribution grid is becoming increasingly significant [4]. The incorporation of renewable energy sources has resulted in an increase in the PQ disturbances that are present in the system. Monitoring the power quality and implementing mitigation strategies go hand in hand [5]. Engineers and designers have been working on a variety of approaches to PQ problem mitigation as a result of improvements and a better knowledge of the issues. As a direct consequence of this, power quality issues are starting to take centre stage in the 3461ashingtg of electrical power systems. When renewable energy sources are taken into account, the task of measuring and moderating becomes much more difficult. In the field of power generation, several forms of renewable energy sources are now in use. Solar, wind, and biofuels are just examples of these sources, but there are many others [6]. To meet the ever-increasing need for electricity, an emerging trend in stand-alone power production mixes two or more different forms of renewable energy. The name for this type of power supply is an HRES [7]. These systems are utilised as an addition to the preexisting grid in order to either offer a backup for the electrical grid or to supplement the power that is produced in accommodate the electricity network. These power sources collaborate to generate electrical power, which is then utilised by both utility companies and individual users. Solar and wind energy combinations are the ones that are utilised the most frequently [8]. Solar panels are used to collect energy from the sun, while wind turbines are used to convert mechanical energy into electrical power. If you live in a distant place or in an area where it would be expensive to deliver power using the usual structure of the power grid and distribution system, then the combination of solar and wind power might be a good source of electricity for you. The quantity of electricity generation generated by various sources has to be measured and regulated in the appropriate way. When the additional electricity that is generated by all these sources is put back into the system, the stakes become even higher [8], [9]. Examining each individual unit, whether it be a household or an industrial load, becomes of the utmost importance. These sources generate power quality disturbances, which are then injected into the main grid, where they result in power and financial losses for utilities as well as for their customers. These disruptions have a deleterious effect on the many distinct types of electrical equipment that are utilised in the electrical grid. Contemporary electrical equipment is extremely sensitive to variations in the power that is supplied [10]. Monitoring the discrepancies is essential in order to facilitate the development of more effective mitigation strategies. In addition to this, the designer will find that it is easier to think of better preventative and predictive maintenance measures. On the basis of this information and in conjunction with the technology of virtual instruments, we devised and finished developing a Labview-based microgrid power quality inspection platform. This article also sets up the reactive power compensation scheme of the microgrid TSC system by utilising Matlab/Simulink software. Additionally, the power quality and power factor of the operation are improved, and the paper verifies the power performance improvement scheme of the microgrid and via simulation. Micro sources of power, energy storage systems, loads, and control equipment are the components that make up small HRES, or high-renewable energy systems. The integration of HRES can be beneficial to the provider of the power system since it can reduce the costs of expansion, minimise the power losses of feeders, increase network dependability, and achieve faster recovery in the event of network failures [11]. The incorporation of HRES into the power distribution system, on the other hand, poses a number of technical challenges, including voltage fluctuations, harmonics, frequency deviations, and grid instability. IoT systems encompassing several smart grid domains, including as production, transportation, redistribution, and consuming, have a number of unanswered research questions, including those pertaining to communications infrastructure and security. However, little study has been done on the underlying communication infrastructures that enable the operation of HRES, and even less work has been done on the communication infrastructures for power distribution systems. These infrastructures are essential to the functioning of HRES. For a variety of smart grid applications, wireless and wired communication technologies are of the utmost importance in order to meet the stringent requirements for dependable operation, administration, and monitoring. Although there have been many studies done on HRES, very little attention has been paid to the design of communication networks. This is done under the assumption that communication networks are always accessible, as is connection with the controllers. Because it coordinates the movement of all of the system's data, the communication network is one of the most vital components that enables a variety of applications for smart grids to function. It is also an important element of the architecture of the internet of things. The goal of this effort is to create an architecture based on the internet of things that will facilitate the incorporation of HRES into the power distribution system. The suggested architecture is composed of four layers: the power layer, the data acquisition layer, the communication network layer, and the application layer. For the purpose of a genuine case study conducted on a university campus, both the performance analysis and the operational practicality of the communication network layer for HRES are assessed and analysed. The following is the structure of the paper: In Section 2, we will discuss the related work that has been done as well as the current state of the art on HRES. In Section 3, we will discuss the IoT-based infrastructure that has been suggested for HRES. Modeling information for various HRES components, such as wind turbines, photovoltaics, energy storage systems, and diesel generators, is presented in Section 4. In Section 5, the results of the simulations and evaluations of the performance are presented. The conclusions and recommendations for further research are included in the final section, which is numbered 6.

1. Related work

The elevated direct current (HVDC) gird, which is characterised by variable connectivity and management, has attracted a great deal of interest from both academia and industry. Inside a subsequent electric grid, the primary sequence will be a combination or dual multi-infeed HVDC that is constituted of edge HVDC (LCC-HVDC) and dc voltage inverters HVDC (VSC-HVDC); in the meantime, the fresh gird trend would then brought both new problems and threats to the stabilisation control and safety of the power grid. After that, a prototype of wind energy assimilation into a dual-feed DC transmission system is formed in Electric, and research papers are performed in both and transient states. First, the article discusses the study works that have been done on the control methods and procedure performance results of LCC-HVDC and VSC-HVDC. Then, the paper discusses the study works that have been done on VSC-HVDC. On the grounds of this, a fresh control scheme for varying wind coming generators to encourage electricians of the Dc link is designed in this paper. In addition, 2 additional active power management sections are intended in the conventional control scheme; as a consequence, Dc power consistency can be gotten better by fast legislation of energetic energy output due to rapid power adaptation of wind generators; simulation results are implemented, and the outcomes will establish a foundation for future research in this area [11]. A topic of discussion in the this piece is electric car technologies, particularly as it relates to the utilization of renewable resources and the assimilation of those supplies into the idea of contemporary automatic (unattended) vehicular networks, abbreviated as ATS. The implementation of this theory results in the creation of an optimal setting for the development and expansion of so-called "Microgrid Systems." This same implementation of electric cars (hereafter shortened to EV) and automatic vehicle traffic systems in smart grids would then lead to a significant reduction in costs and an acceleration of the huge and big onset of electromobility. This, in turn, would then result in the substantially increased stability of electric grids, as well as a reevaluation of the renewable energies that are known today, that will not be constrained by the restricted capacity of the current distribution systems. As just a direct consequence of the connectivity of innovations, a viable approach to the use of renewable energies as a most profitable source of energy for auto parts travel would be achieved, as well as a truly innovative viewpoint on problems involving the consistency of electricity or distributors, and their transition into Microgrid Systems. This will be the case as a direct consequence of the connectivity of technology solutions [12]. In just this work, a new approach for measuring system reliability at the consumer end of a grids system that connects to renewable energy sources for electricity production is discussed. Renewable power photovoltaic panels are an emerging power source with improved results, and features are being developed to support their use. Converters for power electronics and Inverters are being utilised more frequently in distribution channels as a result of the growing peak load. Renewable Energies (RES) are rapidly being linked in these networks. The modelling of the photoelectric (PV) panels is done using the corresponding formulae. The usage of non loads within the power source will result in the production of harmonic currents, which has in turn will result in a reduction in the grade of the supplied energy. The issues associated with the present, such as its imbalance and its harmonic, as well as those associated with inserting the power that is created by renewable energies. Since the 3462ashington is in little on cyclic management, it may be used as a power system to pump energy produced from RES into the grid. This allows the converter to be employed more effectively. The matrix converters with the pro – posed control scheme not only fulfils the total pile reactive power supply when the electricity produced from RES is more than the load power base load, but it also provides the highly expressed peak – to – peak energetic electricity to the grid at 100 % efficiency. This occurs whenever the energy produced from RES is greater than the complete load power demand. MATLAB and SIMULINK are the programmes that are being utilised for this endeavour [13]. Realizing energy connectivity, which is both a more advanced form of electric grid expansion and a new phase of smart power use, requires the implementation of a number of essential tasks, among which is the dynamic management of grid traffic and storage. In this document, an inter scale power factor joint optimization model of active supply chain is founded to "reference" communication in a characterised by an electricity market. Probability mpc is utilised in order to realise gradual regulate layers by layers. The earlier ideal defeating takes into account the market electricity price as well as the yield foresee of sustainable energy microgrids. Additionally, the trying to run country of engaged configurable references and interaction toggles is set up so that as to enjoy the value while helping ensure reliability. The within spinning optimal control excludes output impedance underutilizing data from quick forecasts; Genuine responses clarification focuses on procedure security and performs more exact regulatory oversight based on data from super-duper forecasts to inhibit overvoltage. Both of these optimization strategies work together to reduce voltage fluctuations. In conclusion, the examination of an instance demonstrates that the suggested model and technology has the potential to considerably enhance the efficiency as well as the dependability of the distribution system [14]. Within a micro grid that has one or several connections with main grid, this study offers a system for proactive power sharing between numerous base load power and dispersed generators. When it is linked to the larger grid, a microfinance would preferably behave as either a source of voltage level or a sustain. Nevertheless, in order to attain perfect performance, inherent load changes and the intermittent nature of sources of renewable energy inside the micro need to be efficiently and promptly adjusted for by dispatchable power sources. This must be carried out to achieve correct operation. Although a number of different control system have been documented in the published research to accomplish optimal micro functioning, the mass of the proposed methods anticipated that the micro grid would have a single point of linkage to the larger grid. In the actual world, it's possible for micro inverters to be required to keep numerous're adding with the grid connection active. This could be necessary for a variety of functional and technical reasons, including dependability, electricity restrictions, and needs for restrictions. As a result, a novel approach to active sharing power is described in this article. This approach is designed to be equally efficient for both micro – grids with a single power grid and microgrids with several grid extension. The proposed method undergoes testing to determine how well it holds up under a variety of intermittent operational situations. The findings demonstrate that the proposed strategy is adaptable to a wide variety of real-world operational circumstances [15]. The management of the power system has been presented with challenges as a direct outcome of distributed energies (DERs), battery storage, and microgrids. Controlling the supply and load at the distribution grid is rapidly being one of the most important requirements for this developing system. The era of the Smart Grid presents a number of technical issues, some of which include system voltage, spectral baselining, pro, voltage ride over, and dynamic margin support. A microgrid can serve as a vehicle for the integration of additional distributed energy resources (DERs) through delayed connections to the primary ac grid. This strategy helps to establish frequencies islands, which makes dispersed control system easier. It also has the potential to be useful in a power grid that makes extensive use of renewable sources of energy. The implementation of centralised control and protection (CPC) within a circuit has the potential to bring about considerable benefits toward the accomplishment of this goal. The benefits of adopting CPC, a microgrid tech, for more distributed energy resource (DER) incorporation are discussed in this study, with microgrids serving as a key component of the solution [16]. Unbalanced feeder power and heavy overload of the transformer due to massive access of highly uncertain source loads are becoming an increasingly serious problem in the new energy power system as a result of the high proportion of renewable energy that is being added to the system and the randomness of the load side. A honeycomb topology of the multi-station integrated system is presented as a potential solution to the issues that have been discussed previously. A multi-station integrated system often makes use of the soft open point (SOP) as the primary piece of integrated hardware for the internal unit of the system. Both the honeycomb grid structure and the multi-station integrated system are made up of flexible nodes. Additionally, the multi-network flexible interconnection makes up the multi-station integrated system. The peculiarities of the regional resource endowment determine the degree to which the flow of hydrogen energy is deeply connected in various areas of honeycomb grids. Studying the construction of the new multi-station integrated unit, the power balancing limitations on the unit, and the switching process of the SOP control mode are being done in order to increase the reliability and flexibility of the multi-station integrated unit. Concurrently, the hydrogen electricity coupling structure and the coordinated control strategy of hydrogen electricity conversion are proposed as solutions to the problem of deep application of hydrogen energy. These solutions are aimed at overcoming the obstacles that prevent the widespread implementation of hydrogen energy. In conclusion, the performance of the suggested multi-station integrated system is validated by the utilisation of three simulation models [17]. It is possible that the interconnection of dc microgrids will help to overcome the issues that are caused by the unpredictability of renewable energy producing systems. In this study, a load flow converter (LFC) is proposed as a means of interconnecting two dc microgrids that are located close to one another and controlling the flow of power in both directions between them. The LFC requires to control and apply a voltage in the space in between two dc grids in order to provide power regulation. It is to everyone's benefit if the production of this tv show can be accomplished while utilising so same networks. As a result, a novel idea of connecting outputs and inputs in a parallel and a series fashion is put forward. The LFC is constructed using a full-bridge 3463ashington converter, which is accompanied by the dual active bridges in its formation. It does this by injecting variable voltages into the transmitter in parallel to it in order to manage the power flow here between Clear to understand. In comparison to the electricity that is transferred between answer, the LFC's necessary power ratings is relatively low, and in order for it to function, it doesn't call for the use of any additional power supply. A MATLAB/OPAL-RT-based real-time notable example is utilised to perform simulations of the suggested design. In order to conduct practical investigations into the viability of the proposal, a lab prototype of the system operating at 30 V is being created. The findings demonstrate that the LFC is an efficient means of connecting dc microgrids with one another [18]. A Made by mixing Programming (MIP)-based electricity supply methodology- for decentralised energy networks with electric vehicles is proposed in this study (Evs). This decentralised energy network is a new grid system that is working towards freedom from the present electric grid. The decentralised network relies mostly on renewables as its primary source of energy. Electric vehicles are anticipated to play a significant part in the future mobility and energy network. Electrified vehicles are now able to be thought of as "mobile batteries" due to the fact that the most recent Evs often have big batteries that allow for extended cruise distances. The suggested fix makes use of both the battery in the home as well as the battery in the EV in order to reduce the overall amount of energy that is bought as well as squandered. Because of this strategy, it is possible to minimise the total energy that is bought by the battery of the electric vehicle with the excess energy that is produced at home. The findings of the experiments showed that when an electricity system with rich connections was connected to electric vehicles, the total power that needed to be consumed dropped by more than half [19]. Photovoltaic Power Sources (RES), such as wind energy and Microgrids (DG), have been widely increased in mitigate the impact of climatic changes by reducing co2 of CO_2 carbon dioxide and the use of fossil fuel source. This has been done in terms of the impact of global warming by depletion of fossil fuel creation. The necessity to modify the channel's stability concepts has massively enhanced as a result of the rising prevalence of distributed generation (DG) facilities and the rise in the number of two-way energy flow at the anti – anti and distributor levels. This has led to the gradual creation of suitable dc microgrid that specify some accepted social spectrum for windmills with respect to fault levels, real power, and supplies security. This is a result of the progression of the development of sufficient grid codes. In the upcoming years, this same infiltration of microgrids and renewable energy sources will keep going, which will have an impact not only on the configuration but also on the procedure of substation systems, thereby posing fresh problems for safety designers and operators (no dispatchable or controllable generation). They provide a fault dc supply, which necessitates modifications to the security philosophies of electric power systems feeders, as well as the simultaneous development of functionalities for DG interconnections. The capabilities of the DG connection protection IED may be broken down into three primary areas, and they are as follows: Safety of the system against the effect of the generating units in the event that a failure occurs on the distribution feeder Protection of the generator against faults in the system and unsynchronized auto-reclosure. Protection of the interconnection transformer in the event that a fault arises on the secondary side or in the transformer itself. Following a discussion of the requirements for protection and protection related to the interconnection of distributed generators to the distribution and transmission systems, the paper goes on to describe the functionality of multifunctional relays that can be used to perform such functions. These relays can be used to perform such functions because of the requirements for protection and protection related to the interconnection of distributed generators. The requirements for DG interconnection protection as outlined in the IEEE standard P-1547 are analysed in this study, as are the practises in a variety of countries around the world [20].

2. Proposed Work

This work concentrates on the level of the network here between local controller of HRES and the distributed energy control centre. This is the level at which the status of various sources of renewable energy and loads can be gathered and tried to communicate to a central controller, which then helps determine an adequate step to take within the system. Electricity production in homes can come from a variety of sources, including those that are clean and renewable, such as wind and solar power, as well as traditional sources, including such diesel generators, and energy storage devices, such as batteries. Generators, busses, and loads are some of the other components that are included in the power layer. The three primary categories of loads are residential, commercial, and industrial. Loads may be residential, commercial, or industrial. HRES are intended to create electric power by utilising a variety of power generating resources, including such small-scale wind turbines, solar systems, and/or other traditional sources, including such diesel generators. These HRES are meant to be installed in remote locations. These systems are capable of providing electricity for anything from a single house or structure to a massive system such as a whole village or even an entire island. The mode of operation of the system may be determined to be either grid-linked or freestanding based on whether or not it is connected to the main grid [24]. In the event that the HRES is used in the standalone mode, it needs to be constructed to fulfil the necessary power consumption. Depending on the voltage of the main bus that connects all of the assets, the hybrid renewable energy system can be configured in a number of various ways. These include DC, AC, and a hybrid AC/DC design. In the AC configuration, all of the resources are either specifically linked to an AC bus or connected through converters. On the other hand, in the DC configuration, all of the assets are connected to an Electric bus. In the context of this study, the primary components of HRES are the load, the energy storage system, and the various types of energy sources (photovoltaic systems, wind generators, power stations, and electricity grids). The circumstance of Saudi Arabia was used as a basis for the selection of HRES elements. This is Fig. 1 due to the fact that the costs of generating electricity in remote areas, such as mountainous regions, cities and towns, and semi - desert, are high and present a number of challenges. Some of these challenges include difficult access to rural sites and low density of people. Consequently, the development of hybrid renewable power would be beneficial to so remote places and would minimise dependency on fossil fuels.

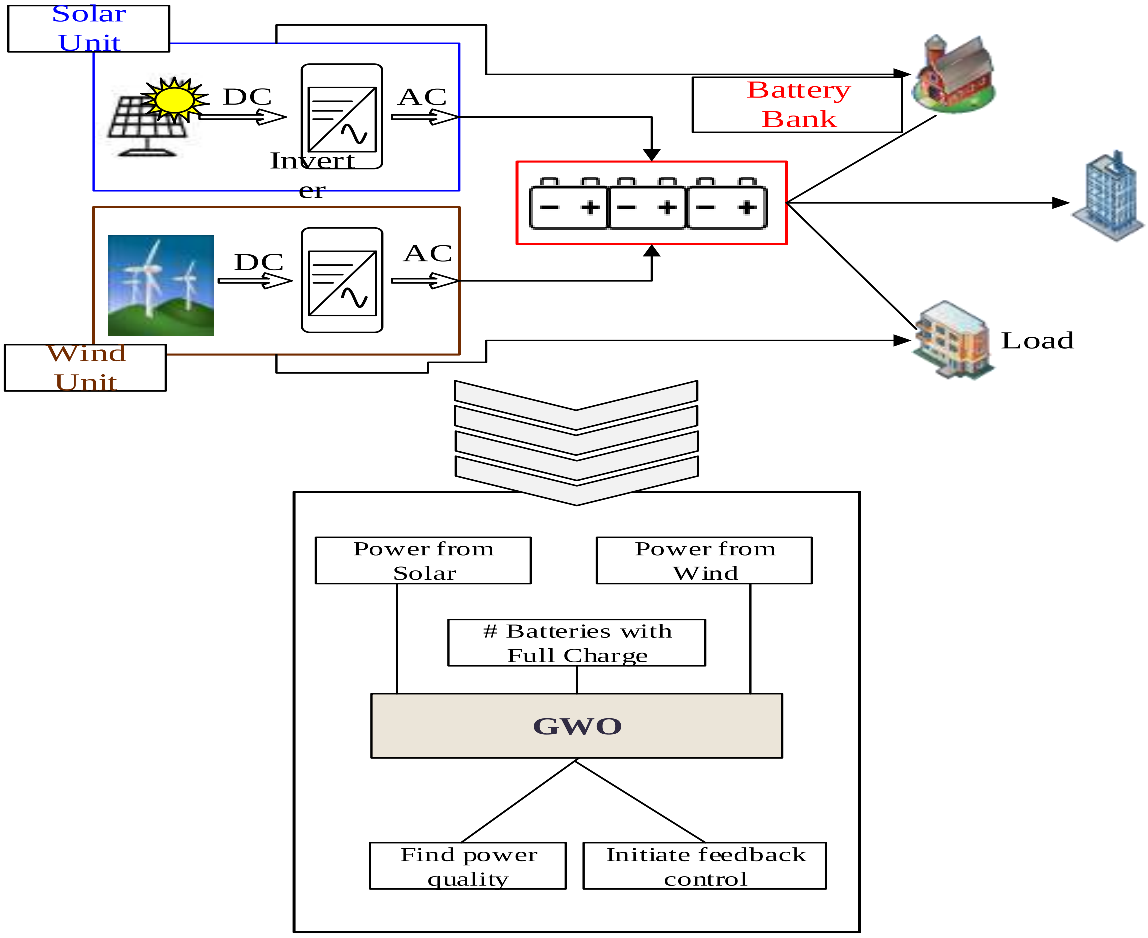

Fig.1. Proposed Work Diagram

The grey wolf optimization technique is a metaheuristic approach that is simple to put into practise. It has been applied to a wide variety of engineering issues. With the help of wolves, GWO is able to lessen the predatory behaviour of its victims. This technique adheres scrupulously to the hierarchical style, with the operational aspect being composed by four groups of wolves denoted by the letters, and respectively. The pack's leaders may be found among the other wolves, and the rest of the pack has been organised into the following structure so that they can locate the best possible answer. There are instances when the wolf pack and the she-wolf pack work together to choose the optimal course of action. On the other hand, as indicated in Fig. 2, is the final pack of wolves that is responsible for maintaining a stable population within the pack.

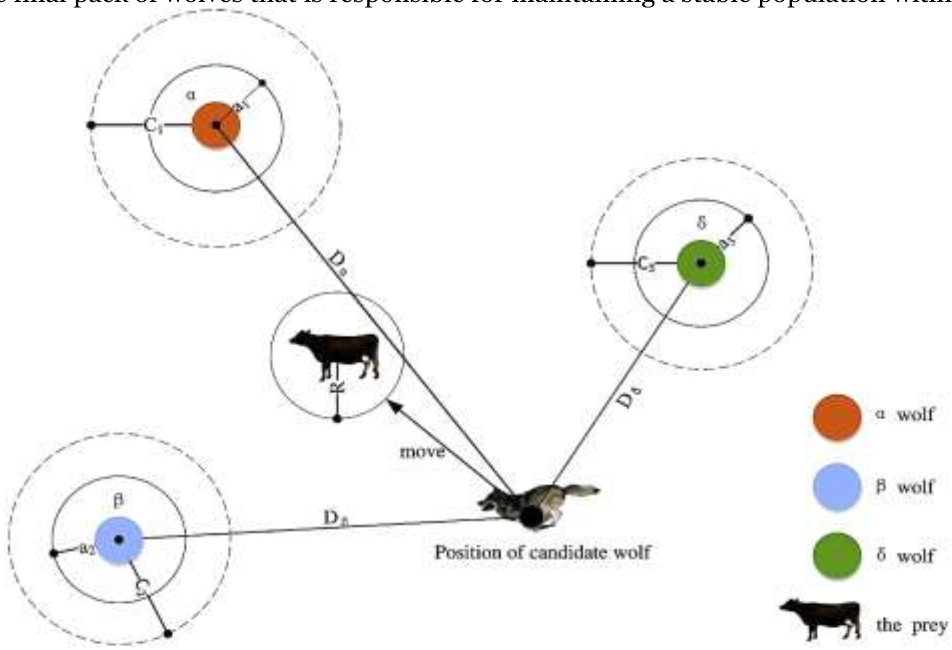

Fig.2. GWO Working

In this method, the prediction process can be divided into three stages encircling, hunting, and attacking.

A. Encircling

In response to the location discovery, the grey wolves have begun to encircle. The following is the solution to the mathematical formula for encircling.

$$D_p = |C \cdot (t) - (t)| \quad (1)$$

$$(t + 1) = (t) - A \cdot D_p \quad (2)$$

Where A, C, D are the coefficient of vectors and t is the iteration number. $X_p(t)$ is the position of the prey and X(t + 1) is the updated position of the prey.

B. Hunting

In this stage α, β, δ wolves have hunted the prey and updated the position of wolves. It can be achieved through equations 3 to 4,

$$D\alpha = |C1X\alpha - X(t)| \quad (3)$$
$$\{D_\beta = |C_2X_\beta - (t)| \quad (4)$$
$$D_\delta = |C_3X_\delta - (t)| \quad (5)$$
$$X_1 = (t) - A_1D_\alpha \quad (6)$$
$$\{X_2 = (t) - A_2D_\beta \quad (7)$$
$$X_3 = (t) - A_3D_\delta \quad (8)$$

$$\boldsymbol{P} = \sum_{i=1}^{N} P_i = \sum_{i=1}^{N}\sum_{k=0}^{k=K} a_{ik}\left[U_{o,i}\left(1 - \sqrt{\sum_{j=1}^{j=i-1}\left(\left\{\frac{1-\sqrt{1-\boldsymbol{C_{T,j}}}}{\left[1+\frac{\alpha_j \Delta y_{ij}}{R_j}\left[\frac{1-2\boldsymbol{a_j}}{1-\boldsymbol{a_j}}\right]^{1/2}\right]^2}\right\}\left(\frac{A_{ij}}{A_i}\right)\right)^2}\right)\right]^k \quad (9)$$

$$CCIIP = \frac{CCI}{IP} = \frac{\sum_{i=1}^{N} P_{R,i}[1 + 0.0027575(H_i - H_{min})]}{\sum_{i=1}^{N} P_{R,i}} \quad (10)$$

$$\boldsymbol{CCIOP} = \frac{CCI}{P} = \frac{\sum_{i=1}^{N} P_{R,i}[1 + 0.2757(H_i - H_{min})]}{\sum_{i=1}^{N}\sum_{k=0}^{k=K} a_{ik}\left[U_{o,i}\left(1 - \sqrt{\sum_{j=1}^{j=i-1}\left(\left\{\frac{1-\sqrt{1-\boldsymbol{C_{T,j}}}}{\left[1+\frac{\alpha_j \Delta y_{ij}}{R_j}\left[\frac{1-2\boldsymbol{a_j}}{1-\boldsymbol{a_j}}\right]^{1/2}\right]^2}\right\}\left(\frac{A_{ij}}{A_i}\right)\right)^2}\right)\right]^k} \quad (11)$$

Where CCIOP is Capital Cost Index per Output Power, and $CCIIP$ is the Capital Cost Index per Installed Power. The 3 objective functions are scaled, adapted, weighted, and combined into one

$$TOF = \omega_P f_P \frac{1}{P} + \omega_{CF} f_{CF} \frac{1}{CF} + \omega_C f_C \frac{CCI}{P} \quad (12)$$
$$\omega_P + \omega_{CF} + \omega_C = 1.0 \quad (13)$$

Total Objective Function:

- Scaling: turning all terms in to the same order of magnitude,
- Minimum turbines' proximity = 3 D
- TolFun = 10^{-15} (default = 10^{-6}),
- ConFun = 10^{-9} (default = 10^{-6}),
- PopulationSize = 10 ~ 50 *nvars* & Generations = 3,000.

3. Experimental Results & Discussion

OPNET Modeler is used to assess the communications program's effectiveness for HRES. The HRES is made up of loads, a solar system, a typical distribution generator (a diesel generator), a diesel engine, and renewable power. Among the most popular renewable power producers for supporting home automation loads are solar as well as wind generation systems. The extra energy produced by solar and wind turbines is stored using a battery storage device. Table 1, the battery systems are charging & sustaining the load at times of increased demand (more than the produced power).

Table.1. Simulation Parameters

Metrics	Values
Voltage at Max Power	40V
Max Power	200W
Current Max Power	5A
Open Circuit Voltage	50.6V
Short Circuit Current	6.5A
No of Cells Per Module	78

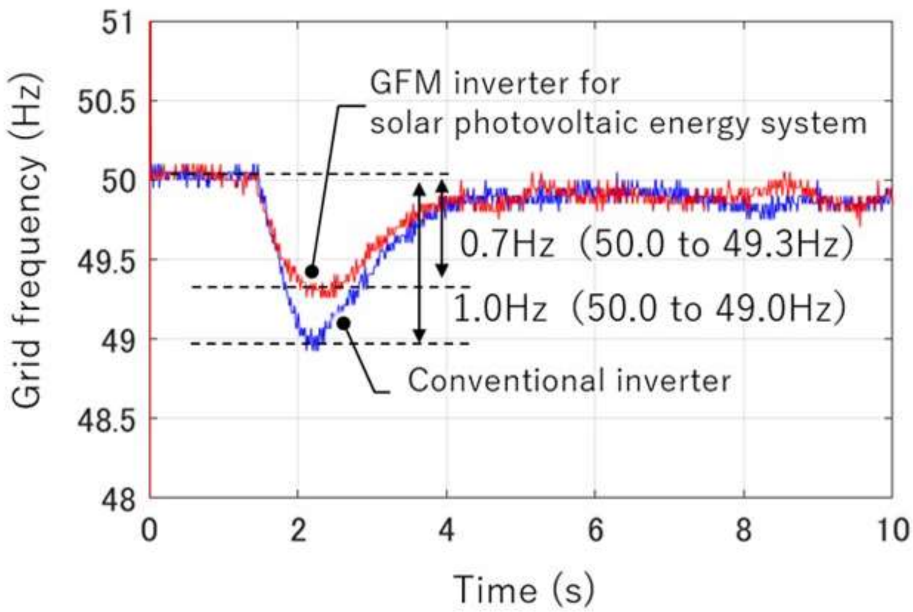

Fig.3.Performance of Grid Frequency

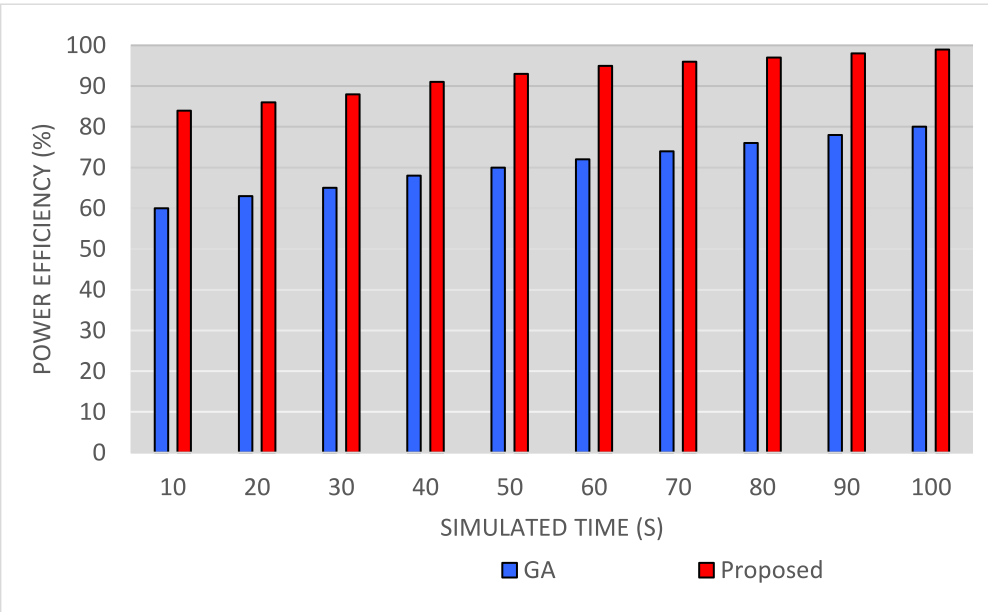

Fig.4.Performance of Power Efficiency

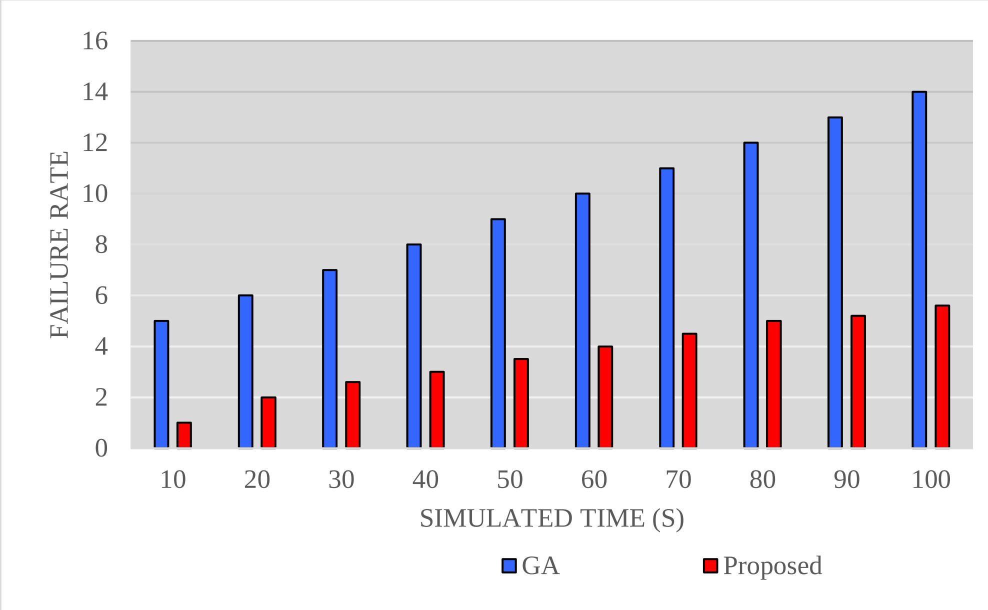

Fig.5.Performance of Failure Rate

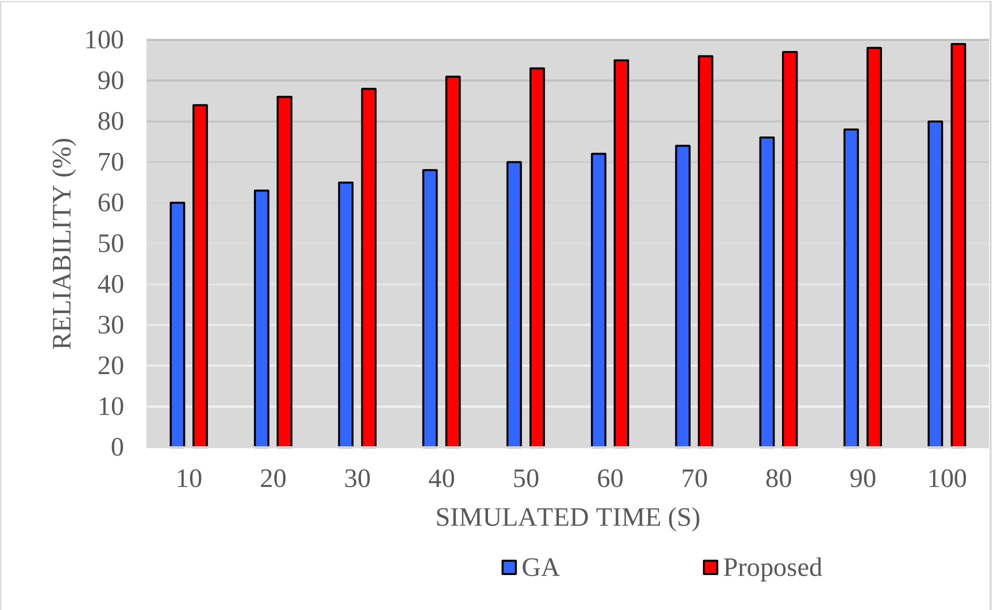

Fig.6.Performance of Reliability

Fig 3, 4, 5, and 6 illustrates the performance of grid frequency, power efficiency, failure rate, and reliability, respectively. The performance of the proposed GWO technique is compared with the GA technique.

4. Conclusion

It's a good trend that more and more energy is being produced by solar and wind energy. Hybrid Renewable Energy Systems (H.R.E.S), commonly referred to as HRES, are becoming more popular in the generator system. Power quality (P.Q.) issues have become more prevalent among users and consumers as the percentage of electricity generated by renewable sources has increased. Electrical engineers will be better able to comprehend the P.Q. disruptions brought on in the electricity system by heterogeneous renewable electricity sources, particularly solar and wind power, as a consequence of this research. What kind of PQ interruptions occur throughout the production of power will be predicted by the research. The project's main emphasis will be the standalone Hybrid Renewable Energies System (H.R.E.S.). In order to improve the mitigation methods and reduce P.Q. interruptions, the information relevant to the energy system will be acquired and analysed. This methodology is known as Grey Wolf Optimization. The suggested approach analyses both the current information gathered from various sources and the data that has already been saved in the past. The information will be obtained and used to drive the technology so that the appropriate mitigation-level actions may be implemented. The system will become more effective thanks to the methods, which will also help the designers improve the system's designability. The monitoring system will be able to foresee the sorts of p.q. disruptions that are created whenever different types of power sources are employed to produce electricity. The device being proposed monitors these p.q. disturbances and classifies them based on the severity of their effects.

References

1. Ghosh, S.S., & Jain, A. (2014). Power Aware Hybrid Proxy Cache-Prefetch Model using Combined Energy Conservation Policies.
2. Golestan, S., Guerrero, J.M., Vasquez, J.C., Abusorrah, A.M., & Al-Turki, Y.A. (2021). Harmonic Linearization and Investigation of Three-Phase Parallel-Structured Signal Decomposition Algorithms in Grid-Connected Applications. IEEE Transactions on Power Electronics, 36, 4198-4213.
3. Nasr, M.S., Aghashahi, M., Rasekh, A., Elsaid, K., Mohtar, R.H., Banks, M.K., Georghiades, C.N., & Abdel-Wahab, A. (2018). A Cyberphysical Testbed for Smart Water Networks Research Education and Development in Qatar.
4. Akkilah, M., & Farsadi, M. (2021). Power Quality Control for Mixed Renewable Energy Systems.
5. Bajaj, M., & Singh, A.K. (2020). An analytic hierarchy process-based novel approach for benchmarking the power quality performance of grid-integrated renewable energy systems. Electrical Engineering, 1-21.
6. Kalita, R., Shah, J.P., & Shashikant Gujar, N. (2020). Measurement Methodology, Instrumentation and Limit Comparison for Power Quality Measurement of Grid Connected Renewable Energy Systems. 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), 75-79.
7. Duque, C.A., Silva, L.R., Soares, G.M., Deckman, I.C., Pereira, J.L., Ribeiro, P.F., Junior, E.L., & Fávaro, A.D. (2020). Continuous Power Quality Monitoring For Power Transmission Systems. 2020 IEEE Power & Energy Society General Meeting (PESGM), 1-5.
8. Florencias-Oliveros, O., Fernández, J.M., Rosa, J.J., Espinosa-Gavira, M., Pérez, A.A., & Salas, J.C. (2021). Instrument for Power Quality monitoring using Higher-Order Statistics 2D planes. 2021 IEEE 11th International Workshop on Applied Measurements for Power Systems (AMPS), 1-6.
9. Kaushal, J., & Basak, P. (2019). A Decision Making Methodology to Assess Power Quality Monitoring Index of an AC Microgrid Using Fuzzy Inference Systems. Electric Power Components and Systems, 47, 1349 - 1361.
10. Tür, M.R., & Yaprakdal, F. (2020). Investigation of Power Quality in a System Based on Renewable Energy Sources.
11. Qian, M., Zhao, D., Ma, J., Zhu, L., Rongrong, J., & Chen, M. (2019). Operation characteristics of DC transmission system with large-scale renewable energy integration. The Journal of Engineering.
12. Stuchly, J., Mišák, S., & Prokop, L. (2015). Prospects for electric vehicles technology with renewable energy sources in a Smart-Grid environment - An introduction. 2015 16th International Scientific Conference on Electric Power Engineering (EPE), 589-594.
13. Aladi, A.Q. (2013). Grid Interconnection of PV Solar Energy Systems at the Distribution Level with Power Quality Improvement.
14. Yongzhen, Z., Hongwei, D., & Haizhou, L. (2022). Grid reactive power optimization research under the background of source network load and storage. 2022 IEEE 6th Information Technology and Mechatronics Engineering Conference (ITOEC), 6, 184-188.
15. Rizvi, S.A., & Abu-Siada, A. (2022). Active Power Sharing in a Micro-Grid with Multiple Grid Connections. Designs.
16. Das, R., Madani, V., & Meliopoulos, A.P. (2017). Leveraging smart grid technology and using microgrid as a vehicle to benefit DER integration. 2017 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT), 1-5.
17. Wang, W., Huo, Q., Zhang, N., Ni, J., Zhu, J., Yu, Z., & Wei, T. (2022). Hydrogen-Electric Coupling Coordinated Control Strategy of Multi-Station Integrated System Based on the Honeycomb Topology. Frontiers in Energy Research.
18. Vuyyuru, U., Maiti, S., & Chakraborty, C. (2019). Active Power Flow Control Between DC Microgrids. IEEE Transactions on Smart Grid, 10, 5712-5723.
19. Sakato, K., Taniguchi, I., Sakakibara, K., Matsumoto, T., Tamaki, H., & Fukui, M. (2016). Optimal power distribution for decentralized electric energy network with electric vehicles. 2016 IEEE 21st International Conference on Emerging Technologies and Factory Automation (ETFA), 1-4.
20. Naisani, P., Tholomier, D., Yip, T., & Lloyd, G.J. (2010). Protection of Distributed Generation (DG) interconnection. 2010 63rd Annual Conference for Protective Relay Engineers, 1-17.