

A Review on Grid Connected Hybrid Renewable Energy System Using Dynamic Voltage Restorer

Gyanoday Kumar, Prof. Vinay pathak

Department of Electrical & Electronics Engg.

BITS,

Bhopal

gyanoday14@gmail.com, pathakvinay2000@gmail.com

Abstract- This paper presents a new system for integration of a grid-connected photovoltaic (PV) system together with a self supported dynamic voltage restorer (DVR). Power quality (PQ) is gaining a great deal of importance as more sensitive loads are introduced into the utility grid. The degradation of product quality, damage of equipment and temporary shutdowns are the general issues associated with PQ problems in industries. Any mal-operation or damage of the industrial sensitive loads results in monetary losses disproportionately higher than the severity of the PQ issues. The evolution of power electronics technology replaced the traditional power quality mitigation methods with the introduction of Custom Power System devices (CUPS). The major power electronic controller based CUPS are DSTATCOM, DVR and UPQC. DVR is a pertinent solution for the economic losses caused by the PQ issues in the industries. Among the CUPS, DVR is the most cost-effective one. In the published literature, only a few papers correspond to the review of DVR technology. In this paper, a systematic review of published literature is conducted and a description is given on the design, standards and challenges in the DVR technology. In addition to the energy variability of renewable energy sources, random voltage sags, swells and disruptions are already a major issue in power systems. Recent advances in power electronic devices have provided a platform for new solutions to the voltage support problem in power systems.

Keywords- Wind, Solar, MPPT, DVR, SVM, DC to DC converter.

I. INTRODUCTION

Human development is related to amplification in power consumption per capita. Over the last 20 years, North America's electricity expenditure has increased gradually by 1.1% in Canada or 2.0% in United States [3]. Still, venture in new powerful power cause (such as dams and nuclear power plants) is politically, efficiently or inadequate.

Transmission investment in 2000 was \$ 2.5 billion less than the venture level in 1975, while electricity sales almost doubled in the same interlude [5].

As shown in Figure 1.1, the US high-power scheme is predictable to approximate the current growth in demand. 5 to 15 years away from electricity command greater than production capacity.

Historically, median energy consumption in the United States is 7.5 times that of Canada, as can be seen from the increase in Small local energy bases, often referred to as "distributed generation" (DG), have become an accepted substitute for high-capacity power production [6]. There are various reasons why DG is becoming more and more popular.

However, in addition to the fact that DG tends to be more durable, DG can be a cost-effective choice for the main organization to achieve maximum shaving or increase carrying capacity. If the required power generation facilities can be built to meet increasing demand, the entire power division or transmission system or also be improved to cope with the extra load.

Therefore, building additional command resources or upgrading the transmission arrangement will cost a lot of cost or time, both of which cannot be achieved. These tendencies are not.Limited to North America but worldwide, power required is probable to binary in next 20 years [7]. The financial losses caused by power outages can be confounding.

The cost of power outages in all business units in the United States has been committed to being approx. \$ 164 billion. More purposely, the normal power outage cost for a medium-sized company is \$ 1,477 per business. Although the price of a second of interruption is significant, an hour's cost (equivalent to 3,600 times duration) is only 4.7 times the cost amplification [8].

Therefore, the initial rapid interruption is very significant to avoid substantial cost effect on the economy. The

distributed producer can help reduce these situations by increase the network close to their firmness limits.

Although the island has some advantages, it also has some disadvantages. Some of them are as follows: After opening or marking the primary source, the DG source will power the system, thereby threatening line workers' safety.

The power or incidence may not be kept within an ordinary allowable level. The island arrangement may be due to insufficient grounding of DG interconnection.

Immediate re-closure may lead to an out-of-phase re-closure of GD. As a result, great emotionless torque or current are produced, injuring the generator or the drive motor [15]. Also, transients can also generate, which can cause damage to utilities and other user equipment. If this occurs at a power peak, off-phase reconnection will produce very severe capacitive switching transients.

In a slightly attenuated organization, peak overvoltage can be close to three times the rated power. [16] The resulting risks include degradation of electronic machinery due to voltage and frequency operation. For these reasons, it is very significant to discover islands swiftly or truthfully.

II. RELETED WORK

Zeng Xiang et.al (2019): this paper offers a new HPQC for quality compensation and power supply. According to traditional methods, the UPQC is often used in the current related energy and power quality (PQ) compensation. By integrating renewable energy, UPQC is able to operate in island mode. However, UPQC suffers from high DC link costs, which increases system costs and losses.

To reduce the cost of DC links, the UPQC has been upgraded to compensate for quality of the power supply and the power injection. However, when the application is not effective, the modified UPQC cannot work on the island mode.

So, a suggestion for a new HPQC topology can work in the event of a technological failure in traditional way. In this article, we will first give an overview of the proposed HPQC topology process. Then, the HPQC basic control idea is given. Finally, to validate HPQC proposal, compared to UPQC and modified UPQC, PSCAD chemical analysis is given for HPQC [4].

Tripurari Nath Gupta et al. (2019): introduced an autonomous energy-based filtering algorithm (AANF) using sustainable energy-based generators to improve the integration of solar photovoltaic (PV), WEGS for public cable. The AANF controller is designed to transmit the basic components of the current radio. The advanced technology provides high sensitivity and resistance to electrical interference.

The main purpose of classification is to provide dynamic power to load, or single network connected to the PCC also mitigates power quality issues such as switching-equality now and the compensation of the force of motion. To achieve maximum power, the MPPT (Maximum Power Point Tracking) algorithm is used based on P&O (disruption and analysis).

The word feed forward about solar energy and energy contribution was introduced to improve dynamic comeback to modify in sunlight and wind speed. The sense of manage offered is simple, and the response of the system is fast.

In a laboratory-developed prototype, the efficiency of the system was tested by heavy conditions, variable light rays, and wind speeds. The performance of planned organization is in line with the objectives of planned plan and the IEEE-519 standard [5].

Zheng Zeming et al. (2019): electronics transformers (PETs) can efficiently manage quality of power, while allowing AC and DC devices to communicate well with the grid, the voltage rating of the PET scheme under interference important is in civilizing performance of organization The stability and design of the security devices in the system are of great importance.

Based on the typical topology of the three levels of PET and its control strategy, the characteristics of the electricity in the port under two major disturbances. The results show that the 1900V state voltage output in the regulator field may be a major indicator of the nature of the PET / DC hybrid system. Finally, technique is used to overestimate severity of PET / AC-based hybrid system failures. The results of the research can provide references to the design of PET safety equipment and the analysis of PET systems [6]

Arshiya Aggarwal et.al (2019): Due to the increasing use of electronic devices, electrical quality disruptions are included in the indicator. To ensure the reliability, safety, and quality of adequate power expenditure, it is necessary to identify and classify power quality interference accurately.

This paper presents an effective algorithm that uses the Convolutional Neural Network (CNN) to exploit assorted features of input power supply, thereby identifying and classifying various power quality disturbances, or then provide them to multiple categories sponsors.

The classifier (MCSVC) performs detection and reconnaissance Classify electrical quality disruptions. Validated from simulation results and verified by industrial data, the performance of the proposed model is better than that of conventional convolution neural networks. This work helps to improve the quality of power

provided for business function, making process of the energy system economical, efficient and safe [7].

Tripurari Nath Gupta et.al (PV), WEGs based on long-range regulated generator (PMSG) generator. The STF-FLL controller is designed to successfully exploit the basic components of a shipment. The advanced technology provides high sensitivity and resistance to electrical interference.

The purpose of the system is to provide a dynamic force to the load and a single plate associated with a PCC. In addition, it also alleviates power quality problems such as distortion of the transmission line, and compensates for the force acting.

The network-connected source converters (VSC) acts as a static circulation compensator (DSTATCOM) without power from a PV line and from a wind turbine, or recover quality of power generated from on plates. STF-FLL technology removes the basic workings of voltage regulator to achieve grid alignment. To achieve maximum power, a point-to-point (MPPT) mining algorithm (P&O) is used.

Introduced the word feed forward on the role of sun and wind, used to recover dynamic response to changes in sunlight and wind speed. The sense of manage offered is simple, and the response of the system is fast. In a laboratory-developed prototype, the system's efficiency was tested by heavy conditions, variable light rays, and wind speeds. The concert of proposed system is in line with the objectives of planned plan and the IEEE-519 standard [8].

Dipayan Guha et.al (2020): this article discusses the frequent instability of hybrid power systems (HEPSs) that are associated with thermal energy production. Initially, a stochastic improvement technique called the sine cosine algorithm (SCA) was used to improve the gain from the derivative control derivative control (FOPI-D) to balance power production or load curvature.

To increase speed the flexibility of alternatives or avoid solutions from local high-level, quasi-opposition-based learning (Q-OBL) is combined with SCA to create QOSCA. In this function, PID controller statement is placed in feedback path to avoid problem being set up suddenly. Shows the comparative evaluation of energy storage devices by analyzing effectiveness of energy storage devices in HEPS.

The qualitative or qualitative appraisal of results shows that planned QOSCA: FOPI-D Controller has best performance compared to the FOPI-D organizer developed by SCA-, Gray Wolf Optimizer (GWO) or Hyperspherical Search (HSS). It can also be seen in the results provided by QOSCA: FOPI-D Controller has anti-interference

capabilities and demonstrates strong effectiveness in resisting parameter uncertainty and load stress. By examining the constraints on power generation, the governor's dead zone, and the influence of boiler power, it is possible to determine the inspectors' effectiveness [9].

Mohammad Javad Morshed et.al (2020): this article presents an expensive and simple design for a wind / photovoltaic system. Their main goal is to have a capable system that meets the requirements of the new plate rules and eliminates the need for inverters for photovoltaic installation. The planned topologies attach PV system to DFIG DC link via a DC-DC converter, thereby reducing cost or eradicate need for an inverter committed to PV power generation.

Under normal circumstances, the DC-DC converter control working power of the hybrid wind / photovoltaic system. In the event of a plate failure, GSC is used as STATCOM to insert immediate energy into the grid, and the DC-DC converter control DC-link currency of the DFIG. To make certain the best presentation, fuzzy PI method is used to automatically adjust the gain of the RSC, GSC or DC-DC converter monitors.

In the event of a one-step, three-step, three-step error and parameter change, evaluate the effectiveness of the proposed strategy. It also compares its performance to traditional electric riding techniques.

The proposed strategy shows that it can reduce rotor speed, improve converter efficiency, reduce power consumption, power consumption and change and protect hybrid wind / photovoltaic systems during power outages. In addition, it can also support the plate by inserting a moving motor during the electric shock[10].

Vikas Shrivastava 2017: This paper establishes the flywheel energy storage organization (FESS) in a long lifetime uninterruptible power supply. The Flywheel Energy Storage (FES) system has emerged as one of the best options. This paper presents a conceptual study and illustrations of FES units.

After brief introduction to the FES system and its theory of operation, the paper focuses on the important role of the FES system in enhancing the operation of the distribution network. Supported by illustrated circuits, the FES system in the improvement of the power quality of the network. A flywheel energy storage technology was ended, with a special focus on the progress in automotive applications.

In order to improve the efficiency and lifetime, then it discusses a newly proposed design of the FES system that emerged recently, which includes the use of Superconducting Magnetic Bearings (SMB) and Permanent Magnetic Bearings (PMB). In conclusion, the paper analyzes the FES systems great potentials that could

be exploited in improving the reliability of the electrical system [11].

Vikas Shrivastava Et.al.2018 -the "smart grid" is a word used to describe the rapid infrastructure replacement of the electrical wiring system in the United States. When the advanced system is totally implemented, it will allow for communication features across the grids that are not currently available--hence the term "smart".

A "smart grid" is simply an advanced electrical distribution system that has the capability to balance electrical loads from diverse, and often intermittent, alternative energy generation sources. In this paper the future trends for this issued development in power systems are assessed.

Then the important evolution factors for developing the substations in the smart grid concept based on ICT (information & communication technology) are identified.

In terms of real-time communications and control functions, interactive between customers and markets, optimized to maximize reliability, availability, efficiency and economic performance secure from attack and naturally occurring disruptions.

By this development, it can be provided advanced EMS (energy management system) and asset management within smart transmission grid. The major theme of the paper is on the use of information technology to acquire more flexibility and smartness in the Wide Area Power System load Protection by designing the Communication channel using WIMAX [12].

Vikas Shrivastava [2017]: The main motive to design this paper to Comparative study between two soft switching techniques used in boost converter. Soft switching techniques are very attractive and medium-frequency applications such as solid often mandatory requirements in medium-voltage and state transformers.

The efficiency of these soft switching techniques is strongly related to the dynamic behavior of the inside stored charge in the utilized semiconductor devices. Intended for this reason, this paper analyzes the performance of the internal charge dynamics in high-voltage semiconductors, giving a clear base to understand the previously proposed zero-current-switching techniques for IGBT based resonant dual-active-bridges.

From these preceding approaches, the two most important concepts that consent to switching loss lessening in high voltage semiconductors are identified shaping of the conducted current in order to accomplish a high recombination time in the previously conducting semiconductors and achieving ZVS in the turning-on device [13].

Vikas Shrivastava, et.al. 2018 This paper presents maximum power tracking system .Maximum Power Point Tracking algorithms (MPPT) are employ to track maximum power, A DC-DC Boost converter is utilizing to acquire the impedance matching among the PV array and the load. The methods based on the perturb and observe (P&O) technique are the most frequently employed in commercial merchandise.

The reason lies in the fact that P&O can be implemented in inexpensive digital devices with ensuring high toughness and a good MPPT efficiency. This paper aims to presents the design and expansion of a photovoltaic system based on the improved P&O algorithm that consent to getting better efficiency, and design of effective charge controller with maximum power point tracker for photovoltaic system.

Stability and accuracy of solar systems and The effectiveness of the proposed solar regulator system is verified by the simulation and experimental results under our developed system with MPPT algorithms [14]

Vikas Shrivastava, et.al [2018] .These paper present Two-stage oil-free centrifugal air compressors can convey noteworthy advantages and open new market opportunities for compressor manufacturers. One of the core technologies following this compressor type is the high-speed electrical machine sustain beside active magnetic bearings. In this paper, the desires set through the compressor on the electrical machine design are existing. The design solutions aimed to satisfy these requirements are discussed in industrial application.

Two case studies demonstrate probable design approaches for the target relevance through examples of a 120-kW, 60 000-r/min induction machine with a solid rotor and a 225-kW, 50000-r/min permanent-magnet synchronous machines (PMSM) with a full cylindrical magnet. The organization design and simulation results are established next to measurements of a PMSM prototype [15]

Vikas Shrivastava, [2021] Transformers are basic design of electrical device which provide power transmission with transforming induced current from one circuit to another. The induced current can be converted step up or step down of current or voltage. This application mainly deliberates on the three-phase transformers which are used in among electric poles and the Power transformers.

The real time overprotective is done on the basic features like gas level, oil aging and regulation of overload and temperature maintenance. These features are essential for effective power transmission and long life of industrial transformers and Communication Architecture for Future Protection & Control of Power Transformer .The monitoring and control of the transformer is done by using IEC 61850 AND RET 620 processor [16].

Vikas Shrivastava, 2021 This paper presents an estimation of SF6 gas circuit breakers reliability in the transmission substations, Among the substation equipment circuit breakers play a vital role when triggered to switch to Control the power transfer based on the load demand situations, Isolate faulty circuits, Prevent system stability failures in case the system parameters are crossing the permissible limit allow maintenance of substation equipment Generally when utilities wanted to procure circuit breakers (CBs) in past as well as today, their preference is always for three pole operated circuit breakers due to cost effectiveness.

This preference continued up to voltage levels of 220kV, beyond which the higher phase spacing has not permitted possibility of three pole operated Air Insulated Substation (AIS) circuit breakers. In Gas Insulated Substations (GIS), the limitation is 170kV for three pole operated CBs, beyond which the size of the tubular housing may become uneconomical. A circuit breaker failure may result in the unavailability of an entire power system, causing major disruption and severe financial losses [17]

Vikas Shrivastava, 2021 This paper presents the design of substation among new technology which increases the concert of substations. The effectiveness of this substation higher than in present substation. And also it reduces the maintenance cost as well as fault happening and also reduces the individual errors and labor cost. One of the important issues in a substation automation system is performance of the communication buses consist of station bus and process bus.

The station bus provides communication between station level devices and bay level devices and the process bus provides communication between bay level devices and primary equipment as the substation communication world searches for the "Promised LAN", it would be helpful to have a roadmap to give direction to the search. Such expectations must be tempered with the cost and complexity of achieving them .In this paper describe a methodology that identified a set of Smart Distribution Grid use cases and utilized them to define an architecture based on Future Internet technologies [18].

III. METHODOLOGY

The current quality is "the expansion of the interval, current, or frequency and the appropriate behavior, which may cause the user's system to collapse or collapse" [60]. The development of electronic electronics technology and the use of long-term equipment have attracted the attention of people to the quality of electricity.

It is understandable that an electrical system transmits system parameters according to standard amplitude, frequency and shape standards. The power system consists of large departments such as power generation,

transmission or distribution companies. Power generation is part of the production of connected power plants. The transmission system is accountable for transmitting generated electricity to the distribution site. The power allotment system is accountable for deal out input feeder from the feedbox gearbox to the output center.

Goods are often divided into commercial loads, household loads, manufacturing loads, city loads and agricultural loads. Profitable or manufacturing loads are the largest consumers with electricity from power plants. Loads can be divided into unloaded goods and goods.

Industrial loads use a feasible control controller (PLC) and a motor driver system with a malfunctioning device. The type of non-linear load provided by a pure wave source absorbs the non-linear element of the current source or influences the harmonics of the source element. The presence of neutral elements reduces the quality of electricity. Due to the increase in cargo size, power generation must meet the requirements to establish the system. The load is suspended and the load change cannot be accurately predicted. Sudden changes in load may cause a setback in the system.

The increase in the type of moving load has a straight impact on power and working force of the system. Decreased Capacitive and inductive reactance will affect the strength of structure. A sudden change in capacitive deceleration will increase the power at the end of the reception, and a sudden change in the inductive response will reduce the power at end of the reception.

The voltage change in the system can be due to countless causes in the electrical system, but the nominal value of the voltage continuation is very significant. An increase in power can damage related equipment, but a voltage drop below nominal value will reduce the efficiency of the connected load and thereby shorten the life of the equipment.

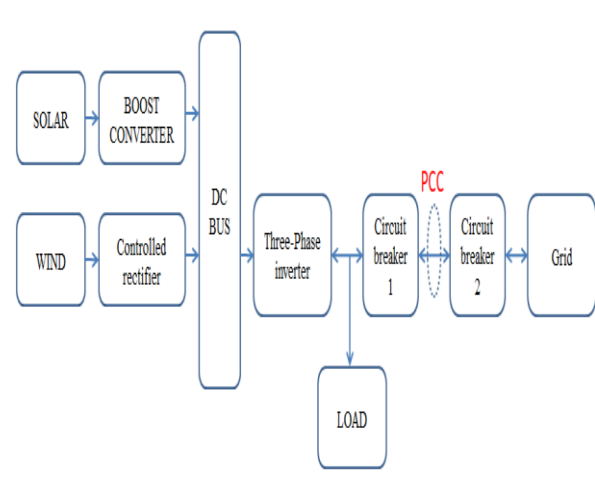


Fig 1. Proposed block diagram.

Power Value: The quality of generated and distributed power has become a significant issue for electricity companies or consumers. Since the late 1980s, the term "power quality" has become a fruitful buzzword in e-commerce. Power quality is the concept of interference in many discrete electrical systems.

The problems covered by the power quality concept are not new in nature, but the cracking factors that solve the power quality problem are now being developed. The common denominator that runs through all of these reasons that has caused people's increasing attention to power quality is continuous improvement in efficiency for all supply customers [1-3]. Current quality is "the deviation between voltage, current, or frequency from ideal properties, which can cause the user's system to go down or go down" [60].

"Power quality is the degree of similarity between the actual system and the ideal system" [61]. Power quality keeps the system power, frequency and power factor within the nominal value. The power or current waveforms are almost close to or equal to the sine curve, giving uninterrupted power.

The construction of the electrical system and the characteristics of the connected equipment can affect the current quality, which is called the current quality problem [6-8]. The power quality depends mainly on the continuity of power supply or quality of the parameters of the power system.

IV. POWER QUALITY ISSUES

Major industrial users insist on using equipment connected to the system to improve power quality, advancing in the industrial control process. The unpredictable nature of the electrical system and the characteristics of the connected equipment can affect the current quality, which is called a current quality problem [8].

DVR for Series Compensation-DVR (Dynamic Voltage Restorer) is a sequence printer integrated with a large power system which contains a VSC with a DC source [19-20]. The major reason of a DVR is to recompense for voltage drop/swelling in the cable passing during the converter. The DVR compensates for the power by finding or enthralling power in power area. The DVR is proscribed by a manage strategy, such as SRF theory.

V. CONCLUSION

The proposed configuration is the integration of a conventional grid-connected PV system and a self supported DVR. The proposed work exhibits all the functionalities of existing PV and DVR system as well as enhances the DVR operating range. It lets DVR to utilize active power of PV plant and thus improves the system

robustness against severe grid faults. The proposed integration can operate in different modes based on the grid condition and PV power generation. The modes discussed here are the healthy mode, sag mode, and PV inactive mode.

The simulation study demonstrates the effectiveness of the proposed configuration and its practical feasibility to perform under different operating conditions. The proposed configuration can be very useful for modern load centers where on-site PV generation and strict voltage regulation are required.

REFERENCES

- [1] Om Prakash Mahela; Kapil Dev Kansal; Sunil Agarwal Detection of Power Quality Disturbances in Utility Grid with Wind Energy Penetration 2018 8th IEEE India International Conference on Power Electronics (IICPE) Year: 2018 ISBN:978-1-5386-4996-1 DOI: 10.1109/ IEEE JAIPUR, India.
- [2] Manoj Hans; Vruksha Kamble Implementation of Hybrid STATCOM System for Power System Performance Enhancement 2020 International Conference on Smart Electronics and Communication (ICOSEC) Year: 2020 ISBN: 978-1-7281-5461-9 DOI: 10.1109/ IEEE Trichy, India.
- [3] Subarni Pradhan; Shadab Murshid; Bhim Singh; Bijaya Ketan Panigrahi Performance Investigation of Multifunctional On-Grid Hybrid Wind-PV System with OASC and MAF-Based Control IEEE Transactions on Power Electronics Year: 2019 DOI: 10.1109.
- [4] Zeng Xiang; Lei Wang; Ying Pang; Man-Chung Wong A Hybrid Power Quality Conditioner (HPQC) with Reduced DC-Link Voltage Rating for Microgrid Applications 2019 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC) Year: 2019 ISBN:978-1-7281-0813-1 DOI: 10.1109/IEEE Macao, Macao.
- [5] Tripurari Nath Gupta; Shadab Murshid; Bhim Singh Power Quality Improvement of Single Phase Grid Connected Hybrid Solar PV and Wind System 2018 IEEE 8th Power India International Conference (PIICON) Year: 2018 ISBN:978-1-5386-7339-3 DOI: 10.1109/IEEE Kurukshetra, India.
- [6] ZemingZheng; JinghongZheng; WenzhiZhao; Zonghan g Han Research on Dynamic Voltage Characteristics of AC/DC Hybrid System Based on PET 2019 IEEE Innovative Smart Grid Technologies - Asia (ISGT Asia) Year: 2019 ISBN:978-1-7281-3520-5 DOI: 10.1109/ IEEE Chengdu, China.
- [7] Arshiya Aggarwal; Nisheet Das; Mansi Arora; M.M. Tripathi A novel hybrid architecture for classification of power quality disturbances 2019 6th International Conference on Control, Decision and Information Technologies (CoDIT) Year: 2019 ISBN:978-1-7281-0521-5 DOI: 10.1109/ IEEE Paris, France.

- [8] Tripurari Nath Gupta; Shadab Murshid; Bhim Singh Single-Phase Grid Interfaced Hybrid Solar PV and Wind System using STF-FLL for Power Quality Improvement 2018 8th IEEE India International Conference on Power Electronics (IICPE) Year: 2018 ISBN: 978-1-5386-4996-1 DOI: 10.1109/ IEEE JAIPUR, India.
- [9] Dipayan Guha; Provas Kumar Roy; Subrata Banerjee; Sanjeevi kumar Padmanaban; Frede Blaabjerg; Dhananjayulu Chittathuru Small-Signal Stability Analysis of Hybrid Power System With Quasi- Oppositional Sine Cosine Algorithm Optimized Fractional Order PID Controller IEEE Access Year: 2020.
- [10] Mohammad Javad Morshed; Afef Fekih A Novel Fault Ride Through Scheme for Hybrid Wind/PV Power Generation Systems IEEE Transactions on Sustainable Energy Year: 2020 DOI: 10.1109.
- [11] Vikas Shrivastava, chris salter "Future Trend To Smart Grid Automation Architecture by IES 61850" International, Conference, Electrical, Electronic, Communication, Mechanical, Computing (EECCME)-2018, IEEE Madras Section, CFP18037, 978-1-5386-4303-7, Vellore District Tamilnadu India, January 2018.
- [12] Vikas Shrivastava, "Research on Structure for Flywheel Energy Storage System in Long Lifetime UPS", India. Int. Journal of Engineering Research and Application, ISSN: 2248-9622, Vol. 7, Issue 11, (Part -3) November 2017, pp.22.
- [13] Vikas Shrivastava, Seema Deshmukh "Analysis and Study between Two Soft Switching Techniques Used in Boost Converter Implementation" International Conference on Electrical, Elect. Communication, Mechanical, Computing (EECCME) - 2018, IEEE Madras Section, CFP18037, 978-1-5386-4303-7, 01-2018-1111, Vellore District Tamilnadu India, January 2018.
- [14] Vikas Shrivastava, "Industrial Design Aspects of High-Speed Electrical Machines among Active Magnetic Bearings designed for Compressor Applications" India. Int. Journal of Engineering Research and Application, ISSN: 2248-9622, Vol. 7, Issue 11, (Part -3) November 2017, pp.22-27.
- [15] Vikas Shrivastava, Seema Deshmukh "Utility Of Charge Controller With Maximum Power Point Tracker For Photovoltaic System" International Conference, Electrical, Electronics, Communication, Mechanical, Computing (EECCME)-2018, IEEE Madras Section, CFP18037, 978-1-5386-4303-7, 01-2018-1113, Vellore District Tamilnadu India, January 2018.
- [16] Vikas Shrivastava, "Designing the Communication Architecture for Future Protection & Control of Power Transformer", India. International Journal of Scientific Research & Engineering Trends, Volume 7, Issue 3, May-June-2021, ISSN (Online): 2395-566X.
- [17] Vikas Shrivastava, "Designing the Communication Architecture in Future Tripping Device", India. International Journal of Scientific Research & Engineering Trends, Volume 7, Issue 3, May-June-2021, ISSN (Online): 2395-566X.
- [18] Vikas Shrivastava, "Designing the Future Communication Architecture for High Voltage Substation", India. International Journal of Scientific Research & Engineering Trends, 9:3 ISSN (Online): 2348-4098 ISSN (Print): 2395-4752.
- [19] Vikas Shrivastava, "A Review on Future Technology Development on Solar Power of Agriculture, Residential and Industrial", India. International Journal of Scientific Research & Engineering Trends, 9:3 ISSN (Online): 2348-4098 ISSN (Print): 2395-4752.