Review on Requirements, Power Converters,and Architectures of Microgrid

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Abstract. The DC microgrids (MGs) are receiving more consideration due to growing DC loads. The importance of DC microgrids related to traditional AC distribution is reviewed in detail. Since microgrids are meaningly more energy efficient when executed with distributed generation.The role of power converters is important in the microgrid operations like voltage boost and conversions. A collection of non-isolated DC-DC high voltage gain converters for DC microgrid is discussed here. Also, the architecture of the microgrid is presented in detail. The power flow among distributed resources and load devices in microgrids has to be properly regulated. Considering this issue, the different control structures are discussed in this article.

Keywords: DC-DC converter; Microgrid; Renewable energy; Voltage gain.

1 Introduction

The utility grid is an absolutely necessary interrelating segment amongst generation and distribution systems. The generated power is transmitted to a high voltage pick-up extent connecting it to the transmission network. The heavy transmission lines are utilized as a part of transmitting power over a long extent. In prior, the electric scheme is made out of steam, hydraulics, coal gas, and so forth. In 1880 electric light emerged in a higher range compared to gaslighting. Everywhere throughout the world, electrification emerged in different eras, and lastly, they were interconnected worldwide in 1938 at 220kV. The normalization is fixed by uniting secluded companies where the frequency and voltage range is settled. In synchronous grid design, the frequency and phase are comparable. The design of the grid fluctuates, relying upon budget, consistency, and production level [1-2].

In prior, the Indian power Grid Corporation outlined the grid operations into five provincial grids [3]. So, it paved the way for high-volume networks amongst the provinces. Through the end of the 11th plan, the country is delivered with an inter-provincial transmission capacity of about 28000 MW which is predictable to cross 65000MW by the termination of the XII plan. The one nation one grid plan is executed to link all provincial grids and to deliver one national frequency. Hence first state grids are unified to form regional grids and thereby developing national grid.The electric grid faces many challenges related to its future development towards improved power generations and distribution [4].

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A. Worldwide Utility Grid System

In the present day, there are fixed reliability standards for planning and operating powerschemes and for addressing safety concerns at perilous electrical infrastructure. These normalizations are improved and enforced by the North American Electric Reliability Corporation (NERC). NERC's activities are monitored and supervised by FERC [5]. When the voltage level increases, the transmission loss gets reduced. When ultra-high voltages are used, the loss is reduced eminently, but the initial cost and requirements will be huge. Novel procedures are made for underlying 1100 kV DC and 1050 kV AC links. To improve the power capacity in Germany, deliberation is made to convert existing AC line DC Transmission losses for few countries are given as below [5-6] in tab.1.

Table 1.DC Transmission Losses.

Country	Transmission percentage
India	18% working on to reduce
USA	6%
EU	6%
UK	6%
China	6.6% was on work to reduce to 5.7% in 2020
japan	5%
South Korea	3%

The non-renewable resource utilization chart [7] for worldwide is represented in below Fig.1.

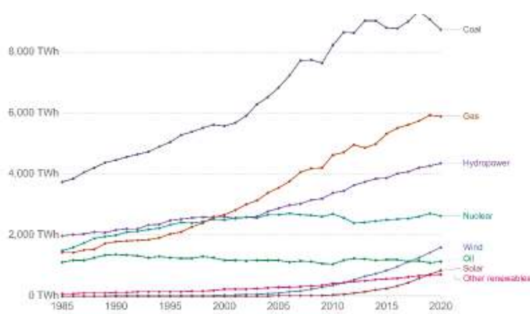

Figure 1.Electricity production by all sources[2].

B. Indian Power Grid System

India's electricity loss is 18%,and it can be reduced by limiting the usage of power at peak time,ie. Between 5 pm-11pm. As the power loss leads to the shortage of power, shutdown often occurs in India,affecting the country's economic growth. The other reason for transmission loss is the Theft of electricity in urban regions. The overall production capacity in the country is 210951.72MW, andthe consumption rate is 146million. Detached from heavy transmission network at 500kV HVDC, 400kV, 220kV, 132kV, and 66kV, hence a sub-transmission scheme is introduced on the distribution system.The national electric grid in India has an installed capacity of 383.37 GW as of 31st May 2021.The resource utilization chart for power generation in India [8-9] is represented below in fig 2.

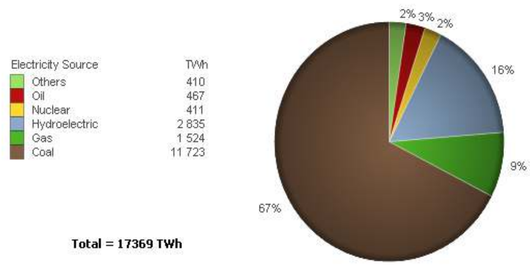

Figure 2.Electricity production in India.

C. Problems due to Power Grid System

Indian confronted the dark condition due to the collapse of high capacity towers due to seasonal effects. The collapse of towers is shown in fig 3. The 765 kV twofold conduction towers connect electrical lines that naturally transmit electricity to the tune of 3,000-5,000 MW, and the fall of more than one tower could conceivably trigger a falling grid let-down, except distinct Special Systems are in set up or the transmission scheme is primped-up to hold such a colossal loss of power. And to daze this power grid hindrance, Micro-grid technology came into reality, and thus this scheme is being advanced all over the world. The below graph in fig 4 shows the outage occurred area and revival time [10-11].

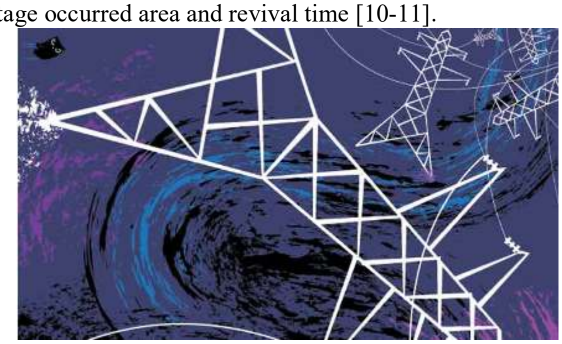

Figure 3.The collapse of high-capacity towers.

Outage due to tower collapse and damage (April-june 2015)

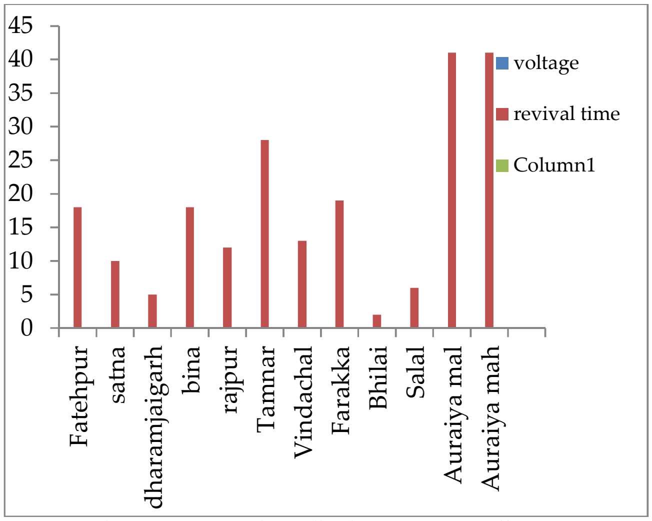

Figure 4.Outage in India due to tower collapse.

A micro-grid is a confined gathering of power sources and loads that typically work associated with and synchronous with the conventional centralized grid (macro-grid), yet can detach and work self-rulingly as physical as well as monetary conditions manage. The micro-grid structure is shown in fig 5.

2 Microgrid And Its Requirement

The micro-grid enterprise is anticipated to look rapid increase in the coming decade. Some describe it as the next market generation of solar, which grew 8-fold from 2010 to 2015, and is forecast to increase by another 119 percent in 2016. Micro-grid and renewable resources are merged and improved in their vitality generation, and many projects are being processed under this scheme. Illustration of Garden Island Micro-grid Project as shown in Fig.6: (1) battery energy storage system, (2) desalination facility, (3) solar PV array, (4) Australian naval base, (5) CETO 6 Project. Image via Carnegie Wave Energy. The edifice of the micro-grid on Garden Island is likely to commence afore the rearmost of the era, and entrustment is intended for 2017.

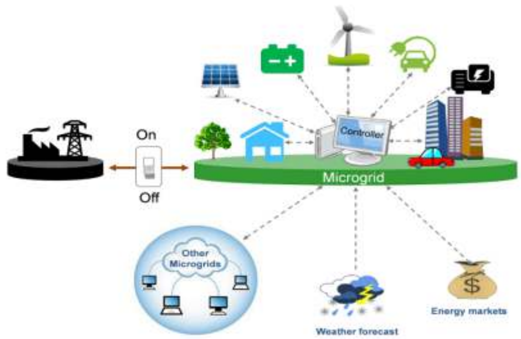

Figure 5. Micro-Grid structure.

The researcher says that the Garden Island project is quickening the commercialization of CETO wave energy equipment by demonstrating the scheme as a consistent and expense-comparable renewable vitality and water resolution in an “island/off-grid-ready micro-grid” setting. “The concept has straight solicitation for distributed generation schemes in remote island environs — especially for places that previously have a high penetration of renewables.”.Researchers estimate the impending for the global microgrid market to attain about US$40 billion by 2020.

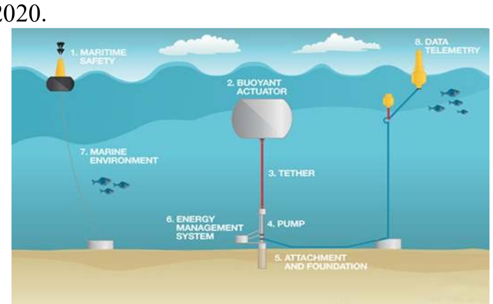

Figure 6. Garden Island Project.

Many micro-grid projects are being in process, such as

-Solar Desalination Micro-grids in the British Virgin Islands

-New York affordable housing micro-grid

-Islas Secas Island Micro-grid.

-Marine-based military micro-grid projects.

The 4Q16 tracker demonstrates North America – the US leads with 54 percent of market share. North America and the Asia Pacific are capable of novel project capacity, and their percentage is 95. North America leads top in operational microgrid capacity. Chinese project on this scheme is predicted to come online by 2020. The analysis says 203.4 MW of solar was supplemented to micro-grids, fetching the entire solar in micro-grids exceeding 2 G.W. Diesel capacity stays as the foremost generation scheme in relation to the total capacity. However, its lead is shrinking, the analyst said. The microgrid growth worldwide [12] is shown in fig 7, and world share is shown in Fig 8.

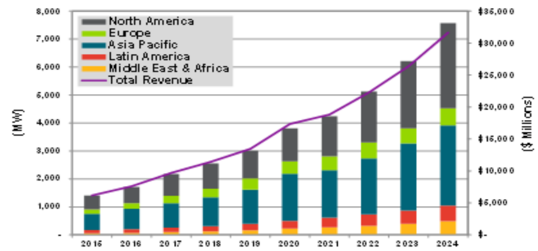

Figure 7. Microgrid growthworldwide.

Total Micro-grid power capacity market share by Region, World Markets 2016 [13]

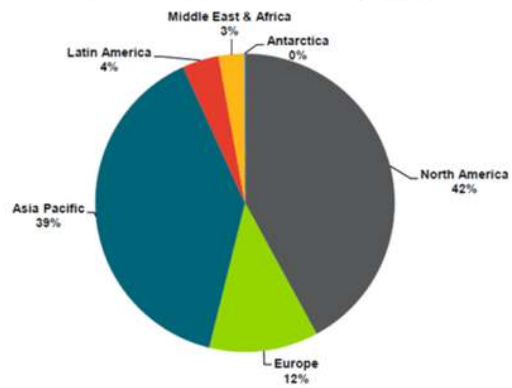

Figure 8. Micro-grid share in the world market.

The Indian Ministry of latest and Renewable Energy's draft countrywide coverage for mini-grids and micro-grids targets to create up to 500 megawatts of capacity over subsequent five years. It trails earlier tasks in getting the subdivision off the ground. India has awful data on giving consistent grid power to huge parts of the country. Various start-ups have made and met challenges; a profitable model seems to be elusive. The Indian government aims to provide around-the-clock sources for all Indians by 2019. The policy is presented in the draft segment," India's US$11 billion rural electrification scheme, called Deen Dayal Upadhyaya Gram Jyoti Yojna, comprises a task of delivering energy to 18,452 villages by 2018. Of these, 14,204 can be aided by grid extensions, and the enduring 3,449 need off-grid power.

The micro-grid scheme is to be executed in the states of Uttar Pradesh and Bihar [14]. They are recognized as a city of darkness. Those people are suffering a lot from the darkness. Micro-grid eliminates the darkness of those cities. The microgrid project executed in Bihar is named "Dharnai Micro-Grid." It's shown in fig 9. The production of 70kW solar power is used for shops and domestic purposes and 30kW of solar PV for the purpose of pumping hydro.

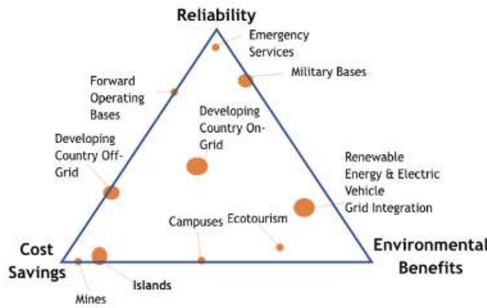

Figure 9. Micro-grid Value Propositions

The additional benefit of micro-grid technology is pollution-free as it can generate power from the rooftop. And in this microgrid production, DC-DC converter plays a vital role [15]. The output of PV ranges from 24-48V, and it's not sufficient, so a boost up of PV source is mandatory, as shown in fig.10. The DC-DC converter steps up the PV input voltage to a higher voltage ratio as output. This review will be helpful in understanding different models of the DC-DC converter, control techniques of the DC-DC converter, energy management, and microgrid (MG) architecture.

3 DC-DC Converters Utilized In Micro-Grid Technology

This section reviews the converter topology. Renewable energy has attracted the view of government, industry, and researcher's alike due to its pollution-free feature. Assortment of DC-DC converters is utilized as a part of the innovation of the micro-grid technique in venturing up the input voltage [16]. The DC-DC converters are of two sorts they are isolated and non-isolated, and they are of boost, buck, and buck-boost converter. These converters are used in the power conversion process obtained from PV, Wind, Fuel cell, Battery [17]. The structure is shown in fig.10. Here in this section, boost converters of high proportion are reviewed. Section 3.1 describes the types and voltage proportion of the converters. And section 3.2 gives the review about different control strategies. In section 4, micro-grid energy management and architecture are reviewed. Section 5 discusses the recent trends, challenges, and future works. And the conclusion is followed in section 6.

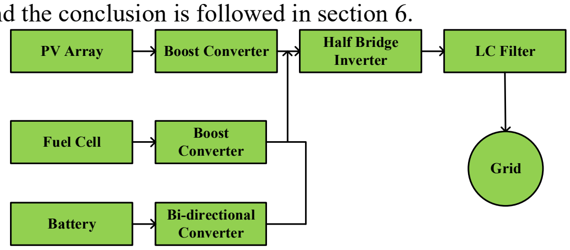

Figure 10. Block diagram of Energy Conversion.

Ching-Ming Lai etal. have proposed interleaved converter for DC MG application. The circuit is of two parts. Where the first one is an integrated energy circuit and followed bya voltage doubler to deliver high voltage gain, it's noted that to improve the gain of the circuit, modules are added in parallel. The efficiency attained is 95.8%. [18]. It is represented in fig.11. In [19] bidirectional extended phase shift control (EPS) DC-Dc converter has been proposed to improve the power distribution process in micro-grid. Here EPS and TPSare compared. Here the stress is less, and efficiency is better on comparing with other distribution components. An integrated full-bridge forward DC-DC converter has been proposed by Leandro roggia in [20] for MG application for residential purposes. The main advantage of it is, it has low active components compared to other devices, less ripple current, high voltage gain, etc. here transformer is absent for integration purposes.

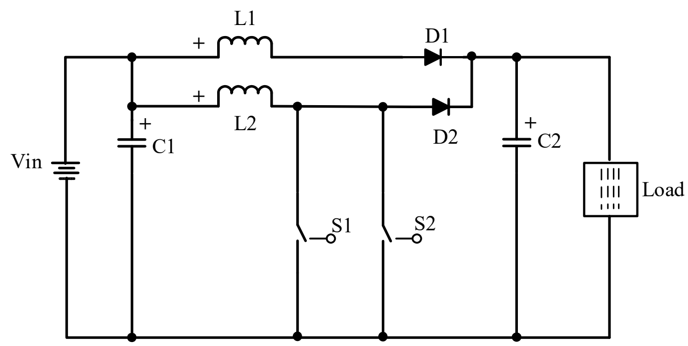

Figure 11. Interleaved Boost Converter.

Shu-Wei Kuo has proposed a dual model half-bridge converter for MG application [21]. Zero voltage switching and adaptive-phase shifting technique are attained during wide load variation. The charging method of three stages has been proposed. Bidirectional three-port converters have been proposed with an advantage of less switch count and with soft-switching techniques. This converter is also used for energy management schemes [22]. The high gain converter is proposed by Manoranjan in [23] for grid power applications. The advantage of this model is reduced switching and conduction loss, less duty ratio, less reverse recovery problem, etc. Back-to-back converters are widely utilized to interconnect MG. The back-back current-source converter has been proposed, and the DC link parameters are also tuned. But due to the DC link system, many disadvantages occur, such as an increase in cost, bulk in size and losses, etc. [24].The energy management control is used to control the generated power from wind and solar for the stability requirement [25]. In fig 12 push-pull converter is shown.

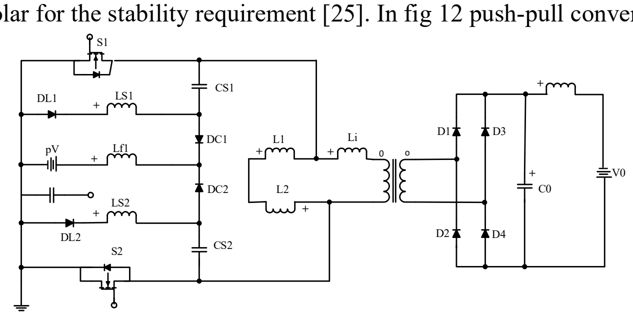

Figure 12. Push-Pull Converter.

Clamp model converter for high gain voltage is proposed by Syed abbas in [26], and it is represented in fig 13. Here the single switch is utilized. This has the feature of low rating of voltage, soft switch characteristics, and lower switching loss with increasing the efficiency. The control characteristics are easy. A single active bridge DC-DC converter has been proposed for residential MG purposes. Here the parallel connection is enabled to improve the voltage gain [27]. A push-pull model bi-directional converter has been proposed [28]. Here interaction of two buses can be achieved. The clam mode technique has been added to control the voltage spike. Soft switching technique has been attained. An isolated modular converter has been proposed by Zhongwei in [29] to attain high voltage gain and utilize it for high power applications. Here Quasi square wave method has been employed. The soft switching is retained here for high-power switches. A novel modulation scheme is introduced for step-down operation, which decreases the switching losses mainly on the higher voltage side of the converter [30].

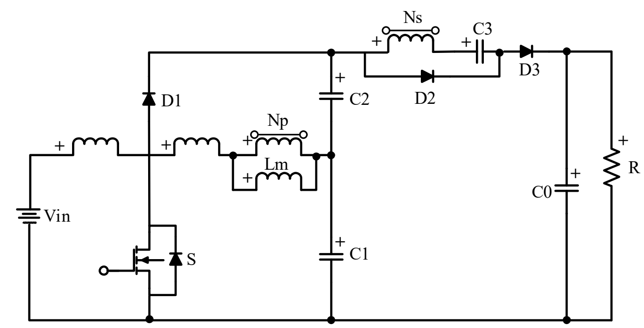

Figure 13. Clamp Mode Converter

Four leg converters have been proposed for current sharing and to retain the unbalanced grid voltage. Here the converters are added in parallel to improve the voltage gain. Voltagequality is enhanced in this model converter [31]. The bidirectional resonant converter model has been designed by Zaka Ullah in [32], and it is shown in fig.14. This converter model has been similar to the LLC type. Soft switching is attained in this model in the absence of clamp design or snubbers. They are utilized for the vehicle to grid applications. Bidirectional quazi source converters have been proposed in [33]. They provide constant boost capability. This scheme has a high stability margin. They are utilized for hybrid MG applications. A transformer-coupled bidirectional converter has been implemented for MG application in [34]. This model has the features of injecting surplus power to the grid, manage demand power, etc. The buck and boost model has been implemented for battery mode and grid mode purposes. The current fed bi-directional dc-dc converter is proposed for the integration purpose of two different bus voltages. Natural commutation is attained in this type of converter. Clamping circuits are absent in this model [35].

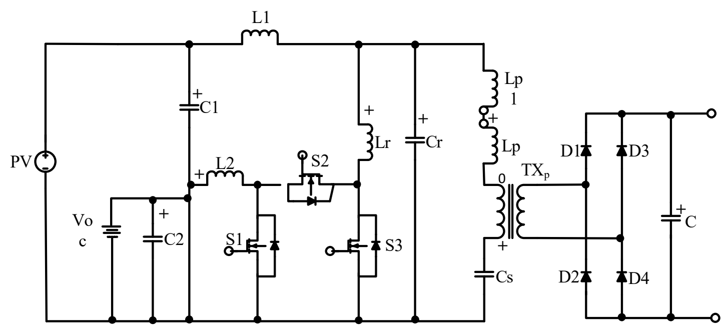

Figure 14. Bi-directional Converter.

Thus, a various number of DC-DC converters have been proposed for MG application. The converters are chosen upto the application required. The comparison of converters models is represented in table 2.

Table 2.The Comparison of Converters Models.

Converter	Voltage ratio	efficiency	Switching voltage	Voltage stress	Duty ratio
Integrated forward boost converter	24V/200V	95.9%	Less	less	0.7
Sepic–flyback converter with coupled inductor	24V/400V	Not constant At 80W gives 96.8% At 110 W gives 94.2%	On the main switch 90V	less	0.5
Clamp mode high step up converter	24V-400V	95.56	less	moderate	0.7
Full-bridge-forward dc–dc converter	24-400V 400V-50V	92.03	reduced	less	0.25
Zvt converter	36V-40V/380V	93%-89.3%	less	less	0.6
Quadratic boost converter	45V/380V	96%	less	less	0.8
High voltage gain	20V/380V		less	less	0.8

Hybrid bidirectional	50V/600V	Exceeds 95%	less	less	0.6
Single switch step-up converter	20V/400V	95%	reduced	less	0.9
Coupled inductive	20V/380V	92.6%	less	less	0.6

The main issue with the working of the DC-DC converter is the unstable control supply, which leads to the scanty capacity of DC-DC converters. There are various analog and digital control schemes employed for DC-DCconverters [36]. Widely the input to DC converter is unstable, and the essential yield ought to be consistent or settled. A voltage controller is utilized so as to settle the voltage range. The different control methods used in the DC-DC converter are presented as follows.

PID control method is one of the oldest control methods, but it's of classical typeas shown in fig 15—any one of these PID.The Controller group is utilized to control the switch. It has many benefits, and it is executed for industrial purposes. Its tuning methodology is easy, and it's still in use [37]. It is a simple, reliable, and easiest implementation technique [38]. The main drawback is not stable for non-linear systems, the rise time is high, and voltage regulation is affected during the overshoot period [39].

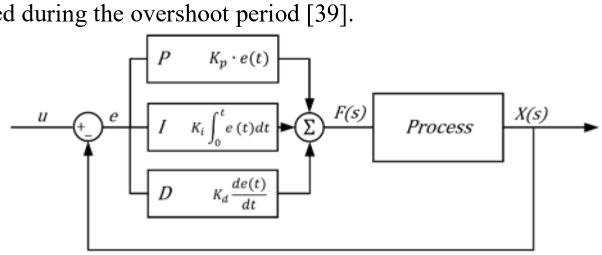

Figure 15. PID controller.

The sliding mode control strategy is the simple approach to robust control.Adaptive intelligent global sliding mode control for the tracking control of a DC-DC converter [40].The main aim of this controller is to model a single boost converter with a high voltage gain for lighting solicitations. Hence, the converter is needed to work in the DCM–CCM boundary to decrease device recovery losses and increase the overall efficiency [41]. And also, it employs a hysteretic controller in the control loop to operate with duty cycles close to the unit without the risk of modulator saturation. Moreover, the converter needs to be controlled through the inductive current since the current active behavior with respect to the control variations is of minimum-phase type [42-43]. When dealing with a hysteretic modulator in a feedback-controlled system, there are three possible methods to tackle the analysis, i.e., describing function, Tsypkin's method, and sliding-mode control. The block diagram is shown in fig 16.

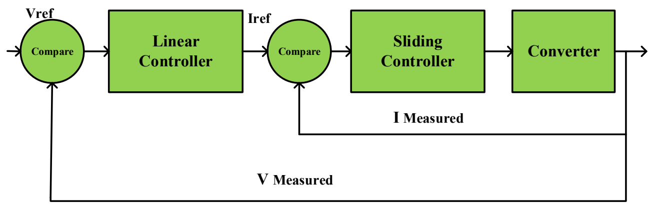

Figure 16. Block Diagram of Sliding Mode Controller

Many control methods are developed for the control of DC-DC converter. To obtain a control method that has the best performance under any condition is always demand [44].An investigation of the boost converter circuit exposed that the inductive current plays a significant role in the dynamic response of the boost converter. Likewise, it can deliver the storage energy info in the converter. Consequently, any variations on the inductive current may distress output voltage which will afford steady-state condition info of the converter. However, the three key parameters essential to be deliberated when modeling boost converters are the power switch, inductor, and capacitor. The aim to attain the wanted output voltage and stability is by modeling the power switch [45-46]. The block is shown in fig.17.

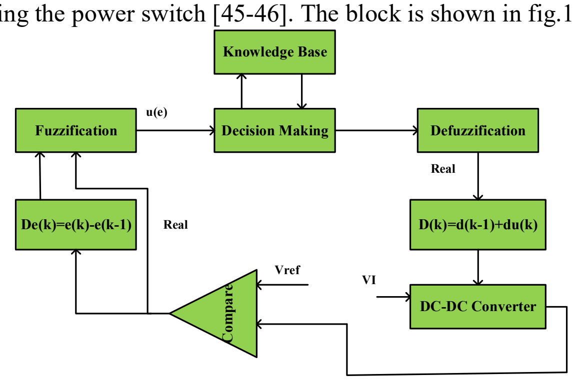

Figure 17. The Fuzzy controller block diagram.

The Maximum power point technique is basically classified into two methods they are a conventional method and a bio-inspired method [47]. Under conventional method perturb and observation method, incremental and conductance method, fractional open circuit and short circuit method, hill-climbing method. Under the bio-inspired method, there are few types they are genetic algorithm, particle swarm optimization, bee colony, flower pollination algorithm, pattern search, etc. This MPPT technique operates depending on the PV I-V curve [48-50]. The current and voltage from the solar PV array or module are the input to the MPPT controller. Then the output is given to control the duty cycle of the converter to attain high voltage gain. The PWM generator acts as an interfacing source between the MPPT controller and converter. The scheme is depicted in fig.18.

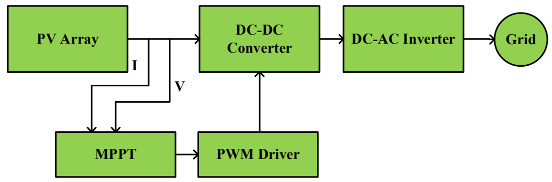

Figure 18. MPPT controller

4 Micro-Grid Architecture

With the growing population trends, the demand for electricity is accelerating rapidly [51].Micro-gird (MG) is a casual scheme of gathering electricity sources and distribution to loads that generally operate and synchronize to the main electrical grid. But it has the ability to disconnect or island it from the main grid and operate separately. The structure of MG architecture is represented in fig 20. The architecture is classified into four parts, They are a) distribution section, b) distributed generation section, c) energy back up section, d) control technique and communication section. MG can be operated for both AC and DC networking systems. Both these networks has energy storage system interfaced with them [52].

Distribution system: TheDS has been further classified as DC line, 60/50 Hz, High-frequency AC line. DC line: The Distribution generators (DG) are probably of DC source type. So,This DC line is used in those DC applications. Hence the DC system is not that popular with the AC system network [53]. The DC line has more advantages than AC depending on cost and safety measures.AC line: MGis normally line frequency. Here the renewable DC source is converted to a 50 Hz frequency AC line to connect to the AC MG system. And from here, they are transferred to the load system [53].High-frequency AC(HFAC)line: The frequency range in HFAC is 500 Hz. At this frequency level, the higher-order harmonics are filtered;thereby,the power qualityproblems are reduced. [54].

Generation Section:The various distribution techniques applicable to interface MG are, Wind energy conversion system, photovoltaic system, hydropower system, geothermal system, bio-gas, and ocean-energy(Fig.19.).

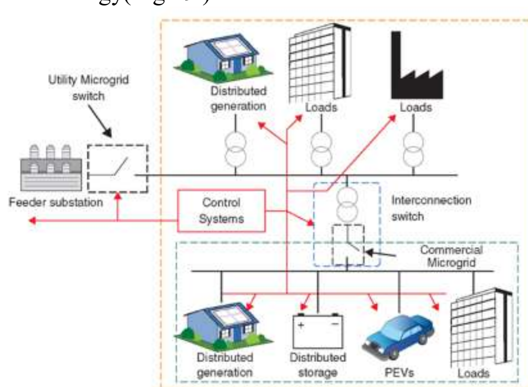

Figure 19. Structure of Micro-Grid.

The Demand Response can contribute to the better integration of 16 renewable energy resources such as wind power, solar, small hydro, biomass, and CHP. In particular, an economic evaluation performed by means of the micro-power optimization model HOMER Energy has been done, considering a micro-grid supplied by a biomass gasification power plant, operating isolated to the grid and in comparison with other generation technologies[55].

Photovoltaic-system: In a photovoltaic system, the generation of electricity depends on solar energy, which is available free of cost. Solar generation is dependent on irradiance and temperature. Alteration in irradiation and cloud conditions plays a vital role in power generation [56]. Changes in this cause disturbance to the power generation. This islands the inverter from the grid. Due to long-term enactment, PV shows the high efficiency of the source and enactment of the converter.

Wind turbine: A wind energy conversion system (WECS) converts wind energy into mechanical and electrical energy [57]. The basic structure of WECS consists of one mechanical and one electrical. The rotational motion is carried out in the mechanical part. The important sections of the WECS are tower, rotor, and nacelle. The generator shaft is utilized to drive the turbine to produce electricity.

Micro-hydro: Here, the electrical energy is generated from the flow of water, and hence it is named Micro-hydro. Due to the changes in the flow of water, the generation of power gets affected. This occurs due to uneven rainfall. A portion of river water is stored in a barrel, and a pipeline is made to pump the water to the turbine to generate the power [58-60].

Energy Storage:Successful operation of MG is processed by storage devices. In addition, some barriers to the wide deployment of energy storage systems within microgrids are presented. Microgrids have already gained considerable attention as an alternate configuration in electric power systems that can operate in grid-connected mode or islanded mode [61].The balance between power generated and demand power [62-64]. There are four methods of storage. They are chemical-battery fuel cell, electrical method either capacitor or ultra-capacitor method, Mechanical method of storage by flywheels or compressed air storage.

Table 3. Comparison of Distribution Scheme.

Interface type	DC bus	60/50 Hz	HFAC bus
Merits	High reliability in nature, less loss, high grid length, dense power, power conversion techniques are absent.	High reliable, easy connection to the grid, galvanic isolation is the possible, less average cost	Less volume and weight, improvement of fluorescent lighting scheme, galvanic isolation is possible for smaller high-frequency transformers.
De-merits	DC link capacitors are used, which increases size. Less voltage levels, galvanic isolation is absent, DC MG implementation is very less.	Large volume and high weight, stringent in nature, load effect is high, grid length is less, line frequency is high,	More cost, grid length is small, higher cost, design, and control is complex, high power loss in the line.

		power conversion technique is required.	
Application	Renewable sources with DC output	AC output renewable sources via induction generator.	Any type of renewable source with dense power.

Energy management: In MG, the energy storage is capable of performing many functions; they are power quality measurement, regulation of voltage, and frequency. Microgrid energy management is a challenging task for microgrid operators (MGO) for optimal energy utilization in microgrids with penetration of renewable energy sources, energy storage devices, and demand response[65].The storage models are of electrical, pressure, gravitational, flywheel, and heat storage technologies. The point of coupling (PCC) is the midpoint where the MG is connected to the main grid. The absence of PCC in MG is called isolated MG, which is utilized in remote areas. Chen etal. in [66] proposed a smart energy management system (SEMS) for optimal operations of MG. This SEMS includesa power-forecasting module, energy storage scheme (ESS), and optimizing module. ESS is utilized to notify optimal operation. In [67] rolling horizon scheme has been proposed for MG energy management. A mixed-integer scheme is utilized for forecasting model problems. This scheme is applied for photovoltaic systems, wind turbine systems, diesel generators, and ESS. The architecture is shown in fig.20.

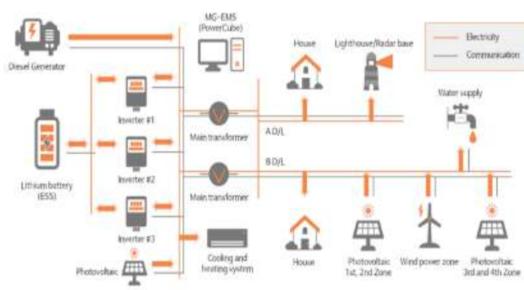

Figure 20. MG EMS.

Distributed Intelligent energy management scheme (DIEMS) is utilized in [56] for the optimization purpose of operating cost. A fuzzy-based ARTMAP neural network scheme is utilized for this management system. In [68] MG energy management system depends on Multi-Agent Scheme (MAS). This scheme is well opted for robust nature, plug, scalable, and extension. This manuscript also describes secondary control scheme depending on MG architecture. In [69] stability droop control scheme of inverters has been implemented for the energy management scheme. It opts for the stand-alone system in MG. The various techniques implemented for the energy management scheme areNitching evolutionary algorithm, genetic algorithm, game theory and multi-agents, Adaptive search algorithms, Mixed-integer non-linear programming [70].In [71], non-standardized control architecture is utilized for EMS in MG energy management. As this controller is used, metering infrastructure is required [72]. This control is suitable for sustained, long-term, and scalable working.

5 Microgrid Control Structures

A microgrid's control system must guarantee all subset functions in various circumstances, including fulfilling load demand and enhancing system efficiency. Power-sharing and bus voltage stability is the primary control problems in DC microgrids. This control might be implemented using one of three types of control architectures: centralized, decentralized, or distributed controls.The control of energy usage within a microgrid is one of the topics that was handled from numerous perspectives [73].

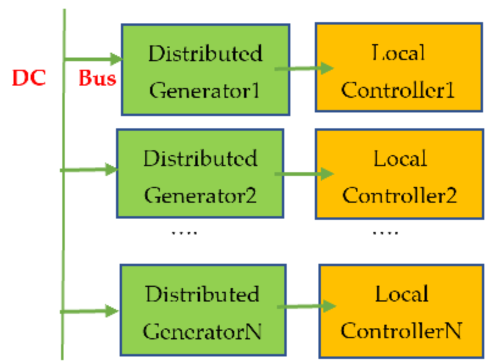

Figure.21.Centralized Control

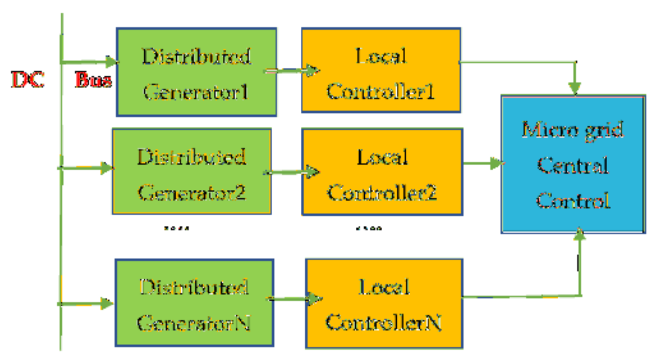

Figure.22.Decentralized Control

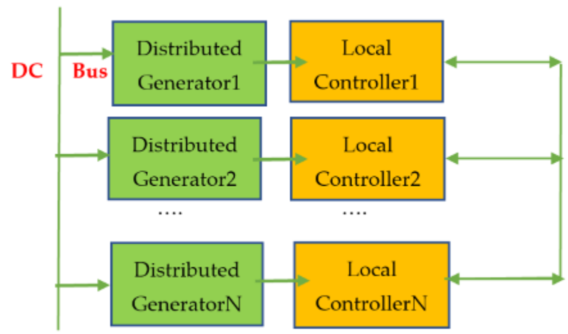

Figure. 23.Distributed Control

Communication-dependent EMS.: Under this technique, the system is dependent on the communication link between DG and MG. the communication details include power sources, security level, technological cost [74-77].

Centralized EMS: The decision or the operation is handled by one control structure. The signals are measured, and transmission among DG is done depending on limits and aims to minimize expense and to improve system efficiency [78-79]. Centralized EMS is shown in fig.21.

Decentralized EMS: Here, each bus or load has a separate local controller. Bus and load operate depending on the instructions received from the local controller. Here computation time is reduced, and the modularity system is improved [80-81]. The decentralized scheme is shown in fig 22.

Communication-less E.M.S.: At the time when communication technique is being cost high, each and every DG unit must be able to communicate separately. Each has its own controller without having any extra controller. The main advantage is the control system is expandable [82-85]. The distributed control scheme is shown in Figure.23.

6 Recent Trends, Challenges And Future Growth In Micro-Grid

Micro-grid is well-developed technology, and it is utilized worldwide. They optimize system operation, heat, and gas consumed, which paves a way to improve its efficiency[86]. Also, a control activity of several micro-sources is difficult to work and highly challenging since all micro-sources have different characteristics. In both centralized or decentralized operations, sure, the operation occurs with a loss in input. Also, there occurs a large mismatch between grid-connected and island mode during the transition, and also between load and generation mismatch occurs. When several micro-sources are connected, a hectic problem occurs during connecting and disconnecting at the same period.

Future development in the micro-grid technique involves,

- Investigation on full-scale development, demonstration of field, performance evolution of frequency control, and voltage control experimentally under various working conditions.
- Grid-connected and island connection transition must be highly penetrated.

- Black starting issue must be analyzed specifically in an unbalanced situation, protection, and power-quality improvement.
- Reliability and security must be improved in micro-grid transformation.

A micro-grid is outfitted with various dispersed energy resources, posing a difficult scenario for power engineers to maintain electricity quality while it is in operation. As a result, monitoring and maintaining power quality is a key problem for the proper operation of a micro-grid system all the way to user satisfaction. Power quality disruptions, if not effectively controlled, might cause an outage of the power transmission and distribution networks in the micro-grid. The micro-grid related power quality issues identification, classification, and decision making techniques are presented in Figure.24.

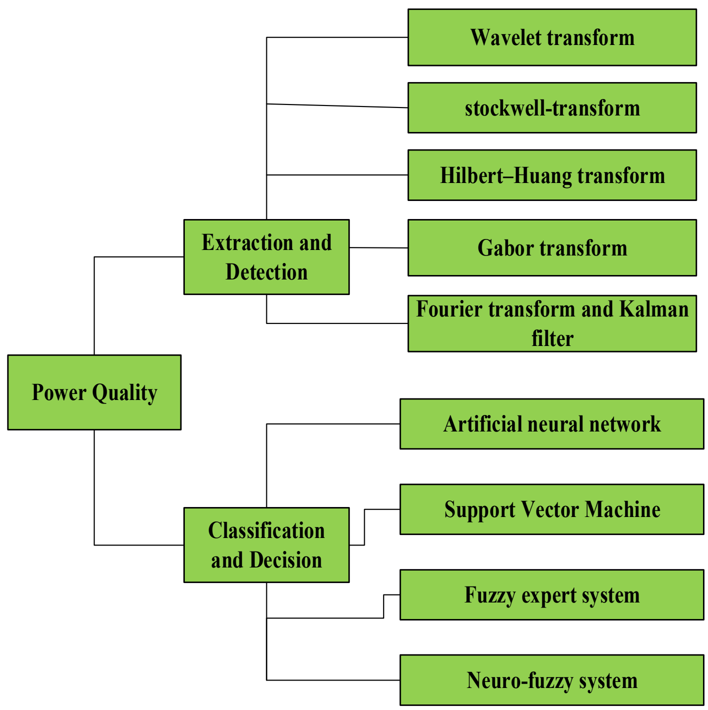

Figure 24.Techniques for Microgrid Power Quality Issues.

7 Conclusion

This manuscript reveals the necessity of renewable energy in the present and how much it is important to our day-to-day life. And also, this paper reveals the importance of the DC-DC converter and various topology of it. It analyses the information of dc-dc converter from various literature. Here the converters of high voltage gain and efficiency are reviewed, which helps the researchers to work on it. The relationship between the Micro-grid and the DC-DC converter is well analyzed in this paper. The control techniques utilized in this conversion are also reviewed. Here it is also analyzed about micro-grid architecture and its energy management scheme.In the future, new technologies like blockchain-enhanced microgrids must be studied in detail to ensure the factors like high security, high transparency, high tamper-proof, and decentralization. The blockchain is suitable for microgrids since it is operating with high renewable penetration and advanced Supervisory Control and Data Acquisition. While incorporating these technologies, the proper study is mandated to know about communication channels and wireless-communication-based control strategy. We know about the penetration of renewable resources in microgrids as they are almost pollution-free and thus atmosphere friendly. In that case, additional pains should be made to resolve the power quality glitches related to renewable energy sources and grid stability. So, a detailed study is required on power quality in the future.

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