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Decentralized Optimal Frequency Control in Autonomous Micro grid by using PR-Controller

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Abstract- As these days DC (DC) microgrids have drawn more thought thanks to the growing utilization of DC (DC) energy sources, energy storages, and loads in power systems. Structure and examination of an independent solar based photovoltaic (PV) framework with DC microgrid has been proposed to produce control for both DC and electricity (AC) loads. The proposed framework involves a solar based PV framework with support DC/DC converter, Incremental conductance (IncCond) greatest electric outlet tracking (MPPT), bi-directional DC/DC converter (BDC), DC-AC inverter and batteries. The proposed bi-directional DC/DC converter (BDC) decreases the part misfortunes and upsurges the productivity of the overall system after numerous trials for its components' selection. Besides, a dependability examination of the DC microgrid framework is explored with a lift converter and a bidirectional DC-DC converter for the framework has been proposed. The overall system is structured and executed in an exceedingly MATLAB/SIMULINK condition.

Keywords- MPPT; DC micro-grid; bidirectional buck-boost converter; solar PV system

I. INTRODUCTION

More than half of the world is still in need of electrification. Most of these areas are far away from the grid and are in a location where it is impossible for the grid to penetrate. Due to this the growth of these areas is substantially affected. This problem can be solved by employing DC (Direct Current) off grid systems according to the needs of these places. The main advantage of employing a DC off grid system is that it can be powered by renewable energy sources directly. This is a good opportunity to initiate the use of

renewable energy technologies in areas where the grid cannot penetrate. As most of the basic appliances like lights, cell phone chargers etc., consume DC it will be easy to incorporate renewable energy technologies like solar PV, wind turbines and fuel cells. The storage batteries used in these kinds of systems also require DC for charging. So the off grid DC micro grid will be suitable for rural areas where grid connection is hard to reach. The DC micro grid and mini grid systems are gaining more and more importance in recent days. Research is being done in this area by developed countries to bring about a change in the electrification of buildings. The DC mini grid is seen as a viable alternative for the existing AC electrification network due to its advantages. DC electrification is not only considered for rural areas but also for urban buildings as well. DC electrification is not a new idea as it was in usage before the arrival of AC as the electrical load was DC back in the old days. The arrival of complex appliances like air conditioning, AC (Alternative Current) motors and long-range power transmission influenced the use of AC electrification. There is a steady increase in the appliances that work on DC and more and more are being invented. Most electronic appliances that we use today such as laptops, computers, TV etc. require DC for their working. These appliances draw AC and convert it to low voltage DC through the adaptors provided for these appliances. This conversion can be avoided if the electrification is DC. Most of the appliances in our daily life consume DC, for example, light bulbs which are in use for a long time. Due to the technological advancements, we now have LED lights, which work by converting AC to DC with a sufficient working voltage. One of the major issues in converting AC to DC is the power loss associated with it. Due to these disadvantages the DC electricity network and mini grid are seen as a viable option to replace AC grid and electrification in developing regions.

1.1 Concept of a micro grid:

A micro grid (MG) can be defined as a group of renewable energy sources and energy storage devices controlled by a monitoring system to provide power to the loads for which it is designed .The energy source may or may not include the local utility grid. A microgrid can be seen as a smaller version of the traditional power grids. The consortium of Electric Reliability Technology Solutions (CERT) describes the concept of a microgrid as a ―aggregation of loads and micro sources operating as a single system providing both power and heat‖. A microgrid consists of power generators, distribution and control systems for voltage regulation just like a conventional grid. However, the main difference between the conventional grid and the microgrid is the close proximity between the power generation and the end users. In recent years microgrids

have gained a lot of attention due to the advancements in renewable energy technologies.

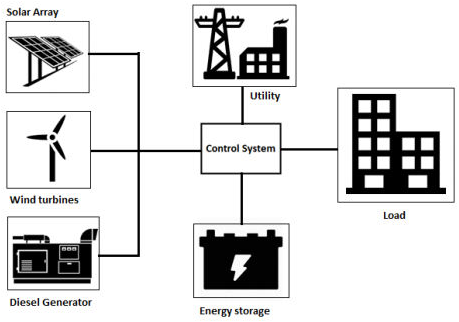

Fig: -Concept of microgrid

The figure 1-1 describes one of the many concepts of microgrids. The figure contains power sources such as solar PV arrays, wind turbines, utility grid and energy storage devices. The diesel generators can be used as a backup power supply or as a regular power source running parallel to the renewable energy sources (RES). The control system denoted is used as a means to regulate the power from various sources to the load.

As the name suggests, microgrids are smaller in size compared to conventional utility grids, which are normally sized at megawatts (MW). Microgrids comprise of micro sources such as PV arrays, diesel generators etc. for providing power for the load for which it is designed. In recent years due to the advancements in renewable energy technologies more renewable energy sources are employed in microgrids.

1.2 Components of a microgrid

A microgrid consists of a primary grid source, distributed generators, energy storage devices, power electronics and control system to manage the power supply from the generators.

Distributed generators (DG) are the most source of power generation during a microgrid. DGs can be categorized based on their technologies such as renewable energy DG and non-renewable energy DG. Renewable energy sources such as wind and solar are being harnessed quite extensively in microgrids. Energy storage devices have become an inevitable part in a microgrid. Due to the increased implementation of renewable energy technologies and their intermittent nature, storage devices such as batteries became a must. Examples of storage devices are batteries, flywheels etc. Electrical load in microgrid systems plays an important role in its operation and stability because in certain applications prioritizing the supply to critical loads is essential. The micro grids can be used to supply power for both residential loads and industrial loads which can be further classified into sensitive loads and non-sensitive loads. Power converters are required in most DER microgrids to convert the generated power to compatible AC power for the appliances. The role of power converters involves power conversion, power conditioning and protection of output interface. Most micro sources require a power electronic device in order for the microrid to work as a single controllable unit.

II. LITERATURE SURVEY

In this section, we have discussed different papers referred, based on Separation of speech based using various techniques.

In [1], a decentralized control methodology for the voltage regulation of islanded inverter-interfaced microgrids. They show that an inverter-interfaced microgrid under plug and-play (PnP) usefulness of distributed generations (DGs) are regularly given a role as a straight time-invariant framework subject to polytopictype vulnerability. At that point, by ethicalness of this novel depiction and utilization of the outcomes from hypothesis of solid control, the microgrid framework ensures security and an ideal exhibition even inside the instance of PnP activity of DGs. It covers multi-layer various leveled control plans, composed control techniques, attachment and-play tasks, strength and dynamic damping angles additionally as nonlinear control algorithms. Islanding identification, protection and microgrid clusters control additionally are quickly outlined [2].

Microrid is another thought for future essentialness scattering structure that engages reasonable force source incorporation. It by and gigantic contains different disseminated generators (DGs) that are ordinarily interfaced to the system through force inverters. For the islanding action of AC microgrids, two huge endeavors are to share the stack demand among various equal related inverters proportionately and proceed with the voltage and repeat reliable characteristics. Different methodologies of intensity sharing control standards are investigated and classifies. At the same time, the control plans are graphically illustrated [3]. In [4] The significant issues and difficulties in microgrid control are talked about, and an audit of cutting edge control procedures and patterns is introduced; a general outline of the most control principles (e.g., droop control, model prescient control, multi-specialist frameworks) was additionally included. Proposed System Classifies microgrid control techniques into three levels: essential, auxiliary, and tertiary, where essential and optional levels are related with the activity of the microgrid itself, and tertiary level relates to the planned activity of the microgrid and in this way the host matrix.

Each control level was discussed intimately. An overview on the selection DG units' setups within the low voltage AC (LVAC) and DC(LVDC)distribution systems with a few applications of microgrid frameworks inside the view

purpose of this and along these lines the future consumer equipment's energy market is extensively discussed. The efficient, specialized and natural advantages of the sustainable power source related DG units, an extreme correlation between the two sorts of microgrid frameworks is given. The framework likewise explores the feasibility, control and energy management strategies of the 2 microgrid frameworks depending on the foremost current research works. Finally, the generalized relay tripping currents are derived and therefore the protection strategies in microgrid systems are addressed intimately. From this literature survey, it are frequently uncovered that the AC and DC microgrid frameworks with multi-converter gadgets are naturally potential for the since quite a while ago run vitality frameworks to get dependability, effectiveness and quality force supply [5].

An optimal power flow problem [6] is formulated so as to attenuate the entire operation cost by considering real-time pricing in DC microgrids. Each generation resource within the system, including the utility grid, is modeled in terms of operation cost, which mixes the cost-efficiency of the system with the demand response requirements of the utility. By considering the first (local) control of the grid-forming converters of a microgrid, optimal parameters are often directly applied to the control of this level, thus achieving higher control accuracy and faster response. The optimization problem is solved during a heuristic way by using genetic algorithms. So as to check the proposed algorithm, a six-bus droop-controlled DC microgrid is employed as a case-study.

The usage of STATCOM and battery energy storage to strengthen the transient stability of large-scale multimachine power systems with synchronous and doubly-fed induction generators (DFIGs)[7]. A passivity-based control plan technique [interconnection and damping task assignment passivity-based (IDA-PBC)] is developed for multimachine power frameworks and its exhibition is assessed on a two-zone framework comprising of two synchronous generators (SGs) and two DFIG nearby STATCOM/battery energy storage system. Presents a totally unique adaptive artificial neural network (ANN) - controlled superconducting magnetic energy storage (SMES) framework to reinforce the transient steadiness of wind ranches associated with a multi-machine power framework during system unsettling influences. The effectiveness of the proposed adaptive ANN-controlled SMES is then looked at immediately of proportional-integral (PI) - controlled SMES advanced by response surface methodology and genetic algorithm (RSM–GA) thinking about both of balanced and unsymmetrical faults. The simulation result which are performed is been confirmed by the proposed framework [8].

The idea was to adjust the internal parameters of power electronics loads to ensure reliable and efficient operation of the DC distribution system is explained in [9]. In this regard, first, an improvement based establishment is proposed for demand response in DC distribution networks in nearness of distributed generators. At that point, the planned issue is understood utilizing both brought together and decentralized methodologies, where the last requires concocting an estimating system. Distributed demand-side energy management strategy requires each user to simply apply its best response strategy to the current total load and tariffs in the power distribution system is shown in[10].The users can maintain privacy and do not need to reveal the details on their energy consumption schedules to other users. They also show that users will have the incentives to participate in the energy consumption scheduling game and subscribing to such services.

III PROPOSED METHODOLOGY

A] Architecture of Proposed Scheme

Demonstrating of the Solar PV System a sun powered PV cluster is frequently displayed in three various manners by using MatLab/Simulink. One among the methods is by demonstrating the part that uses numerical articulations. the resulting strategy is to use the library square of Simpower systems, where a PV cluster are regularly displayed by social occasion PV modules as demonstrated by the predefined power yield. The third system is that the use of the photovoltaic cell.

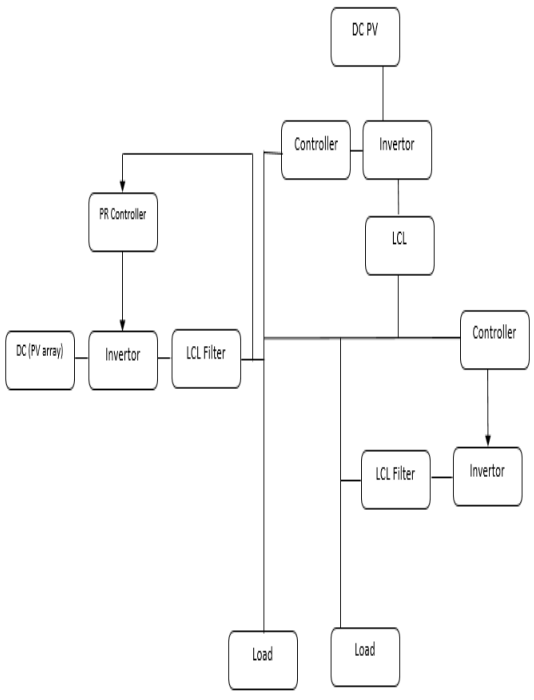

Fig. 3.1 Proposed Scheme

The greatness between this framework and consequently the first is that during this technique the photovoltaic cell square contains the numerical articulation. In our model, we've considered the sun oriented battery hinder from the Simpower frameworks library which was built up by NREL, USA. The PV cluster hinder inside the Simpower systems might be a five-parameter model which uses a present source driven by the sunshine in corresponding with a diode, a shunt resistor, and an arrangement resistor Modeling and Simulation of the Boost Converter A lift converter has been made using a capacitor, an inductor, a diode, and a switch. The OS of a lift converter are frequently explained in two modes. The most part of the lift converter is that the exchanging transistor. It turns some bit of a circuit on and off quickly. Typically the speed of the exchanging are frequently very multiple times each second. Steady Conductance MPPT The photovoltaic yield voltage is on a very basic level a segment of environmental elements, for example, temperature and insolation. Steady Conductance was arranged considering an impression of P-V characteristicwork. The obstruction of the annoy and watch method to follow the tallness power under the quick fluctuating climatic condition is overwhelmed by the IC (Incremental-Conductance) procedure. The IC calculation is that the most usually used system since its results are frequently figured quickly, and its control is easily executed.

Parameters	Values	
	Existing System	Proposed System
Rated Active Power	800W	1000W
Current proportional term	0.35	0.4
Current Integral term	200	500

The IC can check that the MPPT has gone to the MPP and stopped bothering the working point.

IV. RESULT AND DISCUSSION

Parameters	Values	
	Existing System	Proposed System
Nominal Voltage Magnitude	325V	380V
Nominal Frequency	50 Hz	50 Hz
Capacitance of LCL filter	25µF	5000µF
Input Capacitance of LCL Filter	1.8mH	2mH

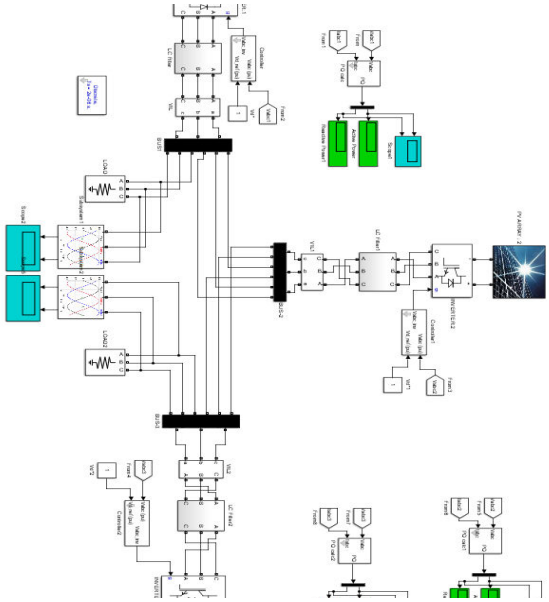

Fig:- Simulation Model

- **Comparison of Electrical and Control Parameter**

Table: - Comparison of Electrical Parameter

Table: - Comparison of Control Parameter

V. CONCLUSION

Important aspects of the solar renewable energy source have been explored. The possibilities of the DC microgrid system and its viability have been investigated. A complete design and analysis have been proposed to effectively enhance the power conversion efficiency of a standalone solar PV system with DC microgrid. A PV array, IC MPPT, a boost converter, and a bidirectional buck-boost converter have been implied to control the battery charging and discharging. The proposed converter decreases the component losses and upsurges the performance of the complete system by peer selection of its components. The proposed complete system lessens the component losses and upsurges the efficiency of the complete system in terms of enhancing the dynamic response, minimizing harmonics' loss, and getting more stable value for the maximum power point.

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