DEEP LEARNING BASED OPTIMAL DC MICROGRID SYSTEM WITH IRNSS SYNCHRONIZATION

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Abstract: *Distributed Generators are gaining significant importance in bridging the gap between limited generation capacities and steeply increasing demands. Thirst for energy is increasing significantly with increase in economy around the world and burdening the conventional grid (CG). Major objective of this research is to reduce the peak power deficit present in CG system and to provide a reliable power supply even in case of grid failure or during blackout. In this proposal, development and evaluation of a small scale grid interactive dc microgrid for residential houses has been proposed. A comprehensive power flow control strategy is explored for different practical scenarios through Simulink model have been developed. A prototype will be developed to validate the simulation results presented during grid connected and isolated mode. An IRNSS -based scheme is used to synchronize the DGs. GPS-based synchronization method is proposed to generate a common time reference to synchronize distributed generation modules. Deep Learning Optimization Technique is used for optimal production and consumption.*

Keywords: DC Micro grid, Deep learning, IRNSS, Synchronization, Solar, Wind, Energy management system

1. INTRODUCTION

The University of Wisconsin established a small laboratory microgrid with a capacity of 80 kVA. 7.2 kV microgrid build in Mad River Park, Vermont, USA. Multiple demonstration projects were successively built all over the world, including Japan's Sendai system (2004), Shimizu Microgrid (2005), Tokyo Gas Microgrid (2006), Spain's Labein Microgrid (2005), USA's Sandia National Laboratories (2005) and Palmdale's Clear well Pumping Station (2006); and Germany's Manheim Microgrid (2006). The concepts of DC microgrid are originated in US. The architecture proposed by CERTS consists of power electronic technologies-based micro sources with a capacity of 500kW. In 2003 the goal for grid modernization is set in US to widely integrate IT and communication technologies into power systems to achieve grid smartness. In view of grid modernization the focus of the US future microgrid is to improve reliability for critical loads, meeting various customized quality demands, minimizing the cost, and realizing smartness. Considering market demands, power supply security, and environmental protection, the European Union (EU) proposed the "Smart Power Networks" program in 2005 [1]. residential lighting and even some communication systems failed to operate [2]. India stood at third place in producing electricity around the globe, still it is having power deficiency, over the coming years demand for power rises as economy because of strong correlation between them [3]. The design methodology and technical specifications of the PV power plant are discussed below [4]. The inverter must be large enough to handle the total peak watt requirement of the zone at any time. The inverter size should be 25–30% bigger [5] than the total wattage of the appliances and machines

2. Develop Simulink model with Deep Learning Optimization Technique for optimal production and consumption

Figure 1 shows the process of deep learning optimization algorithm. In this optimization algorithm the inputs are building end use load data, Electricity tariff data, and distributed energy resources (DER) technology data are given to the deep learning optimization algorithm subjected to satisfy the minimize cost, minimize CO2 emission and reliability after process the outputs are optimal DER capacities and optimal DER operation schedule. Figure 2 shows the input, output parameters of proposed optimization algorithm

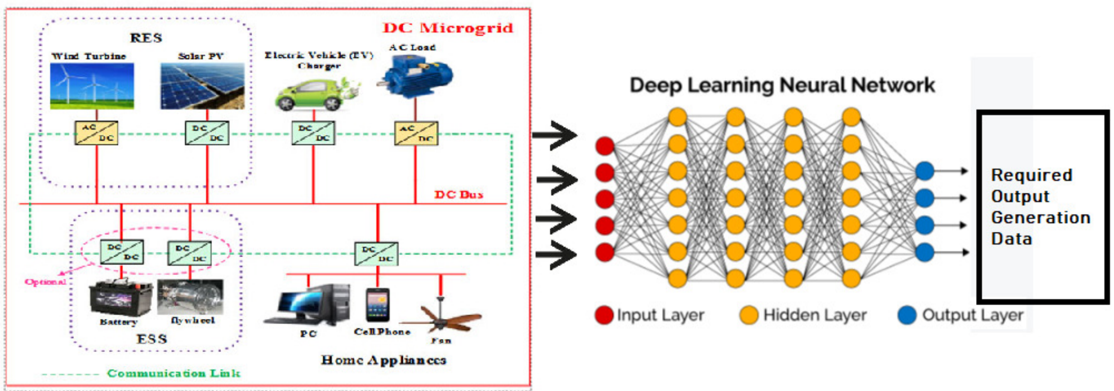

Figure 1. Deep learning optimization algorithm

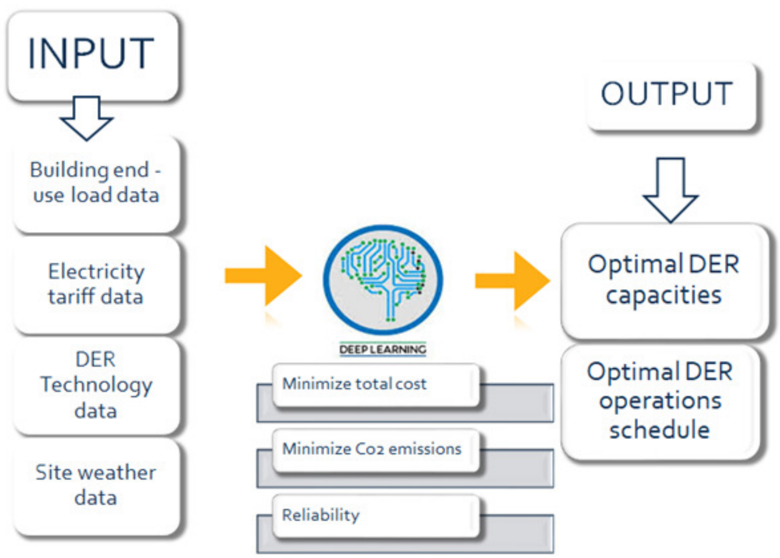

Figure 2. Input and output parameters of Deep learning optimization algorithm

3. D*evelop hardware DC Microgrid prototype system*

Using a DC distribution network, it makes easier to include local renewable energy sources and storage devices. Since modern electronic loads can be supplied with dc without modifying the load itself, it would save the losses incurred during conversions from AC to DC if they are fed directly from AC grid. Grid interactive DCMG system contemplated in this proposal is shown in Figure 3. It comprises of PV source connected to DCMG through unidirectional boost converter, which avoids need of series diode along with PV source that decreases the additional cost and losses in comparison with buck converter. Maximum power from PV is extracted using voltage control instead of current control because maximum power point (MPP) voltage does not change with insolation and provide more benefits like fast tracking, accurate measurement, and faster regulation.

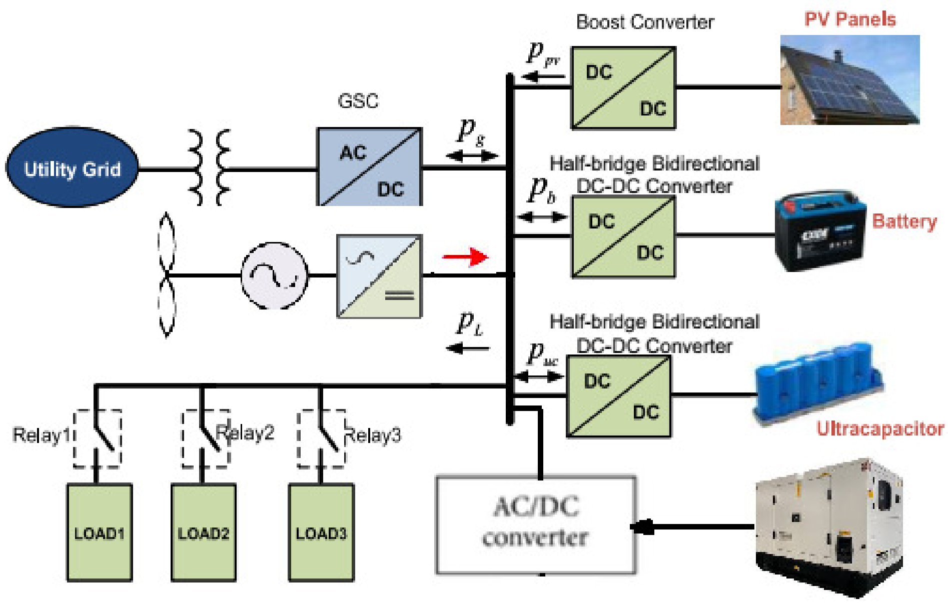

Figure 3. Grid interactive DC micro-Grid

3. Results and analysis

In this paper we simulated 5 kWp wind and 10 kWp solar power generation. Solar and wind power analysis are tabulated in Table 1, cost and IRR analysis are tabulated in Table 2, annual generation units are tabulated in Table 3.

Table 1. Solar and wind power analysis

Plant Capacity wind and solar (KW)	5+10
Generation (Units/Year)	61,200

Costs	INR(Lakhs)
Total Project Cost	15
Rates	
O&M Escalation Rate	2%
Annual Capacity Deration factor(First 10 years)	1%
Annual Capacity Deration factor for years	0.67%

Tarrif increase/annum	4%
Tarrif(INR) /Unit	8
Summary	

Table 2. Cost and IRR analysis

Approx. Energy generation (first year)	61,200	KWH
Cost savings -first year	4,89,600	Rs.
Average cost of generation	1.09	Rs/KWH
Project IRR	35.57%	%
Project Payback	2	Years

Cost Analysis:

Weighted Average Cost/Unit= Rs 1.09

Table 3. Annual Generation units for 25 years

Year	Annual Generation (units)	Year	Annual Generation (units)
1	61200	14	54199
2	60588	15	53826
3	59976	16	53453
4	59364	17	53080
5	58752	18	52707
6	58140	19	52334
7	57528	20	51961
8	56916	21	51587
9	56304	22	51214
10	55692	23	50841
11	55319	24	50468
12	54946	25	50095
13	54573		

Total Cost saving after 25th Year: Rs 165.28 Lakhs

From the above table it is objected that average unit cost is Rs 1.09 and total cost saving after 25 years is Rs 165.28 Lakhs.

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