Smart Micro Grid Energy Management System

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Abstract – a microgrid based on direct current (DC) was designed and simulated. The microgrid's energy will originate from DC sources, and the island's loads will be DC as well. As a result, it was suggested that a microgrid based on DC be designed to reduce the amount of conversion losses between AC and DC. Due to the absence of the skin effect, a microgrid based on DC will have minimal power factor losses, fewer corona discharges, and will be a cheaper and simpler system DC microgrids are already used in data centres, aeroplanes, submarines, and other remote sites in the telecoms industry. The individual components of the microgrid were designed and simulated using MATLAB/Simulink. The island's solar and wind resources, as well as the island's expected load profiles, were modelled. A financial evaluation was carried out. An AC microgrid with diesel-only generation, which is currently in use, had the highest overall costs, while an AC-DC hybrid microgrid was cheaper than the diesel-only system, and a DC microgrid had the lowest overall costs. A technical evaluation of the DC microgrid was carried out

INTRODUCTION

microgrid will be constructed and simulated. The majority of people in rural and some far-flung coastal areas utilise kerosene for illumination as well as cooking alongside firewood. Diesel generators, run and maintained The cost of electricity from a diesel generator varies, and the bill is usually collected on a daily basis. A microgrid will aid in the integration of renewables and will have a good impact on the environment. More than half of the world still lacks access to electricity. The majority of these areas are located far from the grid and in a position where the grid cannot reach. As a result, the growth of these areas is significantly hampered. This difficulty can be overcome by using off-grid DC (Direct Current) systems that are tailored to the needs of these locations. The primary benefit of using a DC off grid system is that it may be directly powered by renewable energy sources. This is an excellent chance to begin implementing renewable energy solutions in locations where the grid is unable to reach. Because most basic items, such as lights and cell phone chargers, run on DC, this will be a problem. Renewable energy technologies such as solar PV, wind turbines, and fuel cells are simple to integrate. DC is also required for the storage batteries utilised in these systems. charging. As a result, the off-grid DC micro grid will be ideal for rural locations where grid access is unavailable difficult to get

METHOLOGY Chosen software

The goal of this thesis is to see if PV-based systems are feasible. As an example, a PV-based AC system is used. SUNERGY, a firm designed and built the reference system. Because the research is focused on the performance of PVbased DC systems,In order to simulate the consequences of a DC-based PV system with suitable software,PV array will be used to generate power in the proposed DC microgrid system, as well as an MPPT.device to fully utilise the PV array's capacity, and storag batteries to provide power as needed There is no irradiation from thesun. The softwares that can simulate a PV DC system

PVsyst

is dedicated completely to the design of photovoltaic systems.It can currently simulate PVAC grid-connected systems as well as PV-DC standalone systems. It includes a variety of library components for choosing an inverter, batteries, and solar PV module.

Performance ratio, yearly and monthly power production, and finally a loss diagram detailing the losses at each end of the system are all possible output outcomes from the PVsyst

Simulink

Modeling, simulation, and analysis of dynamic systems are all done with it. Simulink programming is fairly comparable to Matlab programming in terms of functionality.Simulink makes use of its library, which includes all of the tools needed to create a graphical representation of the programme. This makes it incredibly simple for people who have no prior programming experience to grasp the software.Simulink was not designed primarily to build and simulate renewable energy systems or microgrids, but it does have the capability to model renewable energy systems such as PV, wind turbines, and fuel cells, . It has a large number of libraries, including electrical and electronic component libraries

Modelling of components in Simulink

A solar PV module is a collection of solar cells connected in series and parallel and contained in a protective housing. To create a significant amount of power, the solar cells are stacked in series and parallel.

A solar cell is an electronic device that transforms sunlight into electricity..Matlab/Simulink is a framework that allows any component to be modelled using its mathematical equivalent expressions

. * The first way is to model the component using the chosen component's mathematical equations. Thmathematical expression of a solar cell in this example. In its mathematical equation, the solar cell is represented by its output current

* The next method is to use the Simpower systems library block, which allows you to model a PV array by grouping PV modules according to the needed power output.

* The solar cell block from the simelectronics library can be used in the third way. The difference between this method and the first is that in this way, the mathematical expression (is already included in the solar cell block

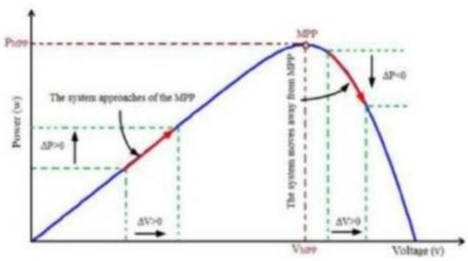
Modelling and simulation of Boost converter

A boost converter is a DC-DC converter with an output voltage that is higher than the input voltage. A typical DC-DC converter is depicted in Figure 3- 5 below. DCDC converters are used in a variety of applications where the supplied voltage is insufficient for the application's operation. Buck and buck-and-buck converters are the two types of DCDC converters. boost converter and converter The buck converter, like the boost converter, modifies the voltage. the magnitude of the voltage provided to it, however the output voltage in this case is smaller than that of the voltage given as an input

(A typical commercially available DC to DC converter)

MPPT charger and its chosen algorithm

Solar energy generation has a lot of potential because of its benefits, such as being environmentally friendly, a good renewable energy source, having no fuel costs, and being simple to install. Despite all of its benefits, there are a few issues with its efficiency, as power output is totally dependent on the sun's strength. To deal with such challenges, an MPPT is employed to fully utilise the solar array's capabilities. Point of Maximum Power MPPT stands for Maximum Power Point Tracking and is an electrical gadget that allows a solar module or array to generate the maximum amount of power possible. It works by monitoring and changing the voltage or current of the array's output power. to a value that is equivalent to or close to the array's maximum power generating capability.

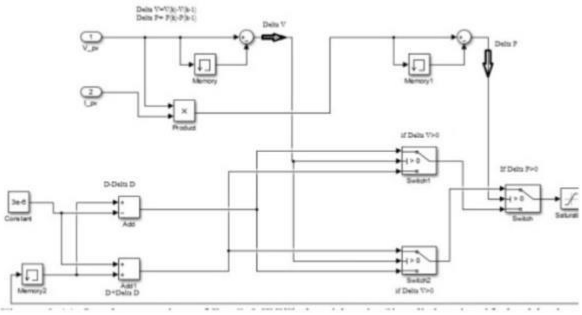


(the figure shows a MPPT curve)

Perturbation and observation method

. Due to its simple structure and algorithm, the P and O approach of MPPT is the most common and sought after concept for MPPT design in solar PV systems. The primary idea behind MPPT algorithms is to analyse and compare the array's output power and voltage to previous similar values

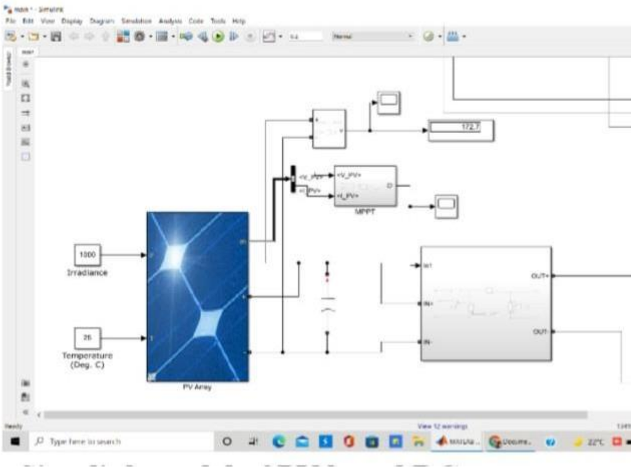
Simulink representation of the P and O algorithm



(Implementation of P&O MPPT algorithm in Simulink using if-else blocks)

Advantages and disadvantages of P and O method

It is simple and straightforward to install; it has fewer parameters to operate, and the power tracked oscillates more around the MPPT area. Because the magnitude of the oscillations is dependent on the size of output voltage variations, it is not suitable for places where the weather changes often.



(Simulink model of PV based DC system P)

Performance ratio using Simulink and PVsyst

The major goal of this thesis is to determine the DCbased PV system's performance ratio. Simulations in PVsyst and Simulink are used to determine the overall performance ratio of the system. The PV array is represented in Simulink together with a PV specialised MPPT, however the rest of theThe performance ratio is then calculated using this energ system is missing. storage batteries a PV-specific MPPT.

RESULT

The results of the Simulink and PVsyst simulations will be described in depth in this section, and the performance ratio will be derived using the results.

Results from Simulink

A disparity in the output finding Simulink is expected, as mentioned in the previous sections. The outputs and Simulink for a day are used in this comparison. For all Simulink simulations result are used in the Simulink simulation

CONCLUSION

a hybrid microgrid provides overall cost benefits Due to the absence of inverter losses, a DC hybrid microgrid requires a smaller initial capital expenditure than an AC-DC hybrid microgrid. This allows the DC microgrid to meet load requirements with less generation, lowering replacement and operation and maintenance costs. Using 100 percent renewable energy to design a microgrid can result in a huge system that can meet the load on days when renewable energy generation is low. This results in an overabundance of energy production throughout the year. A com

promise could be to construct the system in such a way that the The baseload is met by renewables

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REFERENCES

Akerlund, J., 2012. Investigation of a micro DC power grid in Glava Hillringsberg. Akerlund, J., af Gennas, C.B., Ohlsson, G., Rosin, D., 2007. One year operation of a 9 kW HVDC UPS 350 V at Gnesta Municipality data center, in: INTELEC 07- 29th International Telecommunications Energy Conference. IEEE, pp. 40–45.

Akinyele, D.O., Rayudu, R.K., 2016. Technoeconomic and life cycle environmental performance analyses of a solar photovoltaic microgrid system for developing countries. Energy 109, 160–179. doi:10.1016/j.energy.2016.04.061

Ayompe, L.M., Duffy, A., 2014. An assessment of the energy generation potential of photovoltaic systems in Cameroon using satellite-derived solar radiation datasets. Sustain. Energy Technol. Assess. 7, 257–264. doi:10.1016/j.seta.2013.10.002

Bayindir, R., Hossain, E., Kabalci, E., Perez, R., 2014. A comprehensive study on microgrid technology. Int. J. Renew. Energy Res. IJRER 4, 1094–1107.