Effective Utilization of Renewable Energy Sources with Interconnected DC Microgrid

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Abstract: *In this paper we studied the utilization of dc micro-grid with the interconnection of main ac power supply, which is generated from renewable energy sources like sun, wind etc. Micro-grids may Play a Important Role in Future evolution of Energy Sector but the process of generation may be vary. In this paper we observe that the efficiency of dc micro-grid system improve up to 40% when we use renewable energy sources for dc application like mobile charger, laptop charger, led etc because of reduction of ac to dc and again ac which is unnecessary power conversion losses take place with exist system. The microcontroller PIC16F73 is used for the operation of micro-grid system and solar tracker so that we can able to improve the efficiency of this model .when we connected this type of system with particular load the system consumption more power during off grid of renewable generation result more pulse width modulation (PWM) wave form generate which show the loss of the system compare than renewable energy sources.*

Keyword: PIC16F73 Microcontroller, 16x2 LCD Display, Solar cell with tracking system, LM317 Voltage Regulator, 2N3055 NPN Transistor, DC Motor, LDR etc.

1. Introduction

A micro grid consists of interconnected distributed sources like ac/dc load, home appliances & domestic applications. It is used where dominant types of load in dc nature. In india, the most of power plant produces ac power which is suitable for ac types load only. When this power is used for dc appliances like mobile charger, laptop charger, fluorescents light etc, there must conversion from ac to dc power occurred. Hence therefore "unnecessary power processing stages to handle the power generation to user"[1],[9].

The effective utilization of renewable energy sources with interconnected DC micro grid model is used for the enhancing the overall system efficiency .When the powering by renewable source like photovoltaic cell, wind turbines are used as free pollution source of energy which is interconnected to conventional source improve the efficiency of the overall system and fulfill the load requirement. With the dc micro grid solution the energy conversion from dc to ac and back to dc are minimized. The power server accept ac & dc and produces only dc power output. the ac power coming from mains converting into dc with high conversion process and less loss take place. The dc micro grid is directly store the access energy in to battery because battery is best storage device for dc system. Today we are using renewable energy to protect our environment. The solar photovoltaic cells are useful for this in our country, because in our country large amount of solar radiation is available. In this there is three parts these are generation, transmission and distribution. It is divided into region wise, the first region is generation, the second region is generation and transmission, and in third region these three are there. But solar energy is variable type due to variable solar radiation is obtain on the earth or on the solar PV module, so the variable source is major impact to control on it and provide controllable source of energy. This cannot be controlled but the maximum available solar radiation on the earth surface is obtain with the help of simulation and integrating generation system of solar energy by varying tilt angle of the panel. The efficiency of the PV module is also depend on the dust collected on the PV cells or PV module, the efficiency is reduces with the increase of dust on the PV cells so the dust from the PV modal have to remove and keep the PV cells dust free because due to it the efficiency of the PV modal is reduces up to 50 %, but here consider dust free PV modal and adjust the tilt angle to obtain optimum output power. The fossil fuel cannot sustain the need of the energy and also it gives emission to the environment which causes the green house effect. So it is necessary to see for the alternative energy like solar energy. Solar energy is of two types these are solar PV and solar hybrid thermal, among this two solar PV has more efficiency then solar hybrid. But to increase this two are used together in the same available roof surface are and this way the maximum roof surface area is utilized. The cost of the PV modal is also one of the major effects on the development of the solar system, so to reduce the cost of PV system the different types of construction is made with the help of different material and it is used according the application. In this way the cost of solar PV system is reduces and the efficiency is increased and also the further research is going on the latest material used in solar PV module to increase the efficiency of PV module.

2. Present Status of Energy Requirement

Role of scientists and Engineer is to make 'conventional Energy sustainable' and 'Renewable Energy Available' [2].At present status 34% of total energy requirement by oil to fulfill by only 28% so remaining energy fulfill by coal while natural gas fulfill 20% of energy requirement and 2.8% of global energy requirement for nuclear so 16.2 % of global energy required so this energy is fulfill by renewable energy. Today we need ever more energy and to find long term sources of energy. If we talk about present point of view the larger electric power is generated in thermal power plant but in future it will not in continue, so we need to develop as a new renewable energy source as solar energy. According to

International Energy Agency (IEA), about 1.3 billion people worldwide lack access to electricity services with nearly 2.7 billion without clean cooking facility. 404 million people in India currently do not have access to electricity and the daily average per capita electricity use is about 2 kWh for connected people [3].

Table 1: Requirement of energy sources

Energy Source	Requirment (%)
Natural Gas	20
Coal	28
Nuclear	2.80
Oil	33
Renewable Energy	16.20

Present status of renewable energy sources

Table 2: Present status of renewable energy

Renewable Energy	IN MW
Wind	21,262
Solar	2,647
Hydro	3,802
Biomass	1,365
Bagasses Cogeneration	2,510
Waste To Power	105

3. Methodology

- In this model, The 16x2 display all the parameters value (solar panel, wind motor and mains supply ,bus bar ,LDRs) in form of voltage only ,which is in Dc nature & shows the value of solar output panel which rating is 5 watt in their display.
- All the parameter is adjusted by the PIC16F73 microcontroller which is the latest technology up to now. It uses the 5 volt supply for most of operation take place.
- When the mains is on operation mode then the total power generated through renewable sources is also supply to the distributed load, hence result for minimization of conventional sources. The transistor is used for standby operation when off load or on load occurring in this model.
- The voltage regulator LM317 is used for controlling the motor which is used to generate artificial wind applications. when speed of motor is high then output through wind is also high.
- The LDR sensor used for the solar tracking purpose. Where the potential difference occur at high level compare to other then it operate fast and absorbed the photons which are emitted from sun or artificial sun (incandescent light)
- In this model, the whole bus bar is protected, the value of bus bar does not exceed beyond 9.99 volts. Hence, the solar panel output does not exceed 9.99 volts. When the solar panel, wind generator and mains are in operation then excess form of energy used in storage form.
- By this approach, the overall plant efficiency become maximized & we can protect our limited fissile fuel at large scale.

4. Result

- Renewable sources of energy like wind, solar; increases the efficiency of the system up to 40% compared to fossil energy sources [1].
- No need of any conversion take place in this type of systems
- The use of solar energy & wind energy wake up for future generation.
- By the help of this model at large scale, the conventional sources can be save at large scale so that our future become blissful.
- When the solar tracking mechanism operation take place ,the efficiency of the panel increased due to extraction & emission of electrons take place at very fast speed and maximised the generation occurred
- When the full load is on and renewable sources of energy is off then bus bar voltage is 5.91 v take place, when renewable sources are in operation mode at high intensity and high speed then bus bar voltage is 9.91 v which shows the voltage efficiency of the small model.
- Increase in efficiency of bus bar in term of voltage is the ratio of "load connected to mains only" and "load connected to the renewable sources with mains"
- When the power supply to the load through main ac sources, then the more pulse width modulation occurs in this model while when the renewable sources supply the power to load the minimum pulse width modulation (PWM) exist. Hence the use of renewable sources in system shows the improvement of the efficiency in the system.
- The electricity Produced from the solar panel is time varying and fluctuating in nature. Hence MPPT is used to extract optimum electricity from sun [3],[10].
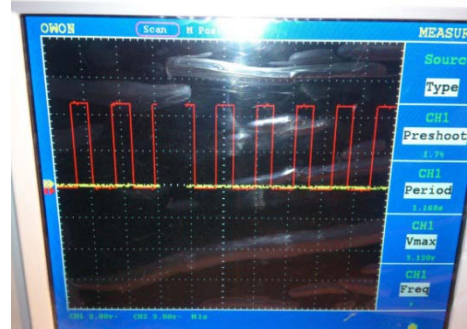

Figure 1: The maximum PWM when using Main power supply

Figure 2: The minimum PWM when using Renewable supply

5. Conclusion

India's Energy generation and consumption are on high growth rate with 40% of 1.20b its population depressed of grid electricity, present 186 GW installed power capacity may have to be doubled by the end of this decades to needs of its growing population and expectation of high GDP growth economy for the off grid generation of power to fulfill the energy requirement by micro-grid employ the great role for country economy. Hence We conclude…

- The efficiency of photovoltaic module and wind sources of energy are very much useful compare to fissile fuel power generation. Hence smart grid technology is the best option for minimized the consumption of conventional energy sources.
- The Interconnected systems are very useful in regional areas & education sectors, when off load occur in these areas. It always in the standby mode, when conventional power sources fail then it can operate quickly.
- It can save energy up to 15% and enhanced efficiency up to 40%.

6. Future Scope

There are following future scope of interconnected renewable source of energy with conventional energy;

(1) Integration of multiple renewable energy generation to a common Sink DC Bus.
(2) Facility to Draw from DC to AC when Off Load DC.
(3) Implementation of a DC micro grid with variable /various DC power voltage & current options.
(4) The speed of operation can be increased by using power extraction technique.
(5) In future we can use implement this model at large scale and generative huge amount of power and help to enhance our country economic growth.
(6) The performance of these types of model can be improved by implement the various types of software technique.
(7) It can be implemented in High Way side with hybrid system for online electric vehicle technology.
(8) There will be many technologies, where we will implement in this existing system with new technique so that efficiency improve.

7. Acknowledgement

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