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Power Monitoring in Hybrid Power System with Fault Detection

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Abstract— This project focuses much on the efficiency of monitoring process of Hybrid Power System and Fault detection. It aims to build a hybrid power system which is completely reliable on renewable energy sources on the generation side and monitor the power from Solar and Wind energy sources through a DC microgrid implementation. The system is automatic with the use of sensors and controller for monitoring and detecting the possible faults that occur in the DC grid. Faults detected are indicated and in a swift the relay operates protecting the load from possible damage that could occur due to fault.

Keywords—DC Nanogrid, Hybrid Energy, Solar, Arduino based, autonomous

I. INTRODUCTION

We require electricity for operating the majority of the appliances we use in our day-to-day life. So, it has become an important part of our life. Now there are two ways to supply electricity first by using non-renewable sources of energy and second by renewable sources of energy. With increase in population and advancement of technology, consumption of electricity is additionally increasing exponentially. Simultaneously, we've to increase generation of electricity also to fulfill the stress of growing population. The largest disadvantage with the usage of conventional resources is that their usage causes pollution thanks to the assembly of varied pollutants like ash just in case of a coal station, smoke just in case of diesel power station, stuff just in case of atomic energy plant. Maintaining these pollutants isn't a simple task, and it also requires lots of cash. So, we've got to seek out another methods to supply electricity. The simplest possible way is by using non-conventional sources of energy. Out of all the possible options available in non-conventional sources of energy, solar and wind are the simplest methods. As tidal energy is used only on the ocean shores, ocean thermal energy may be utilized in the center of the ocean and its setup is additionally very difficult. While solar and wind are available all told the areas of the globe and fitting their powerhouse is additionally not a cumbersome task. Energy from Solar and wind for power generation may be a promising solution pleasing the stress of both the agricultural and concrete population. Utilizing the renewable energy can overcome several issues within the environment like environmental pollution, degradation of fossil fuels resulting in heating may be reduced therefore, and also the ecological balance and atmospheric condition is maintained. We are able to supply to GRID also, just in case our consumption less and generation is more. In our project we are specializing in the employment of renewable energy and build up a hybrid power grid with an automatic power monitoring through sensors and controller. Also sensing of parameters like voltages & current which successively helps us program to detect faults if any and monitor faults through relay operation.

II. LITERATURE REVIEW

M.Tech Scholar Kurukshetra university in their paper discusses about hybrid power system implementation through Simulink model. Comparison of wind and pv system has been made in this paper, and specifications, principle to supply power to grid has been discussed.

Mergu Chandramouli (IJEREEE) dicusses about SWHES i.e Solar Wind Hybrid Energy Systems, the need for solar wind energies as they are clean sources of energy with abundant availability in nature. They are pollution safe and doesnot effect environment.

Snehal Namdev Mitak in their paper explains the use of the green energy technology powe power generation, the possible application of wind and solar for providing power to house. Use of green energy for domestic purposes is discussed with its possible uses and results

Yandra Shivrath (IJMER) comes up with a innovative idea of powering pumps in agricultural fields with hybrid stand alone system.

Dicusses about the scenario of entire country and requirement for its implementation in India.

2019 IEEE APAP in their paper explains about the battery storage technology with its possible applications, usage and more. They also focus on the control logic technology, need for it and possible techniques that can be employed.

III.DESCRPTION OF PROJECT WORK

Our main objective is to build a hybrid power system which is completely reliable on renewable energy sources. Monitor the power from Solar and Wind energy sources through a DC nano grid implementation. Where in a DC nano grid is a local power system which is independent of the main grid in generation and utilization of power on its own. They are used in areas with less population and isolated geographically. Here electrification is possible through Hybrid Energy Systems which is the most effective way to electrify remote and isolated locations as compared to conventional grid. Monitoring and analyzing the system using Controller i.e. Arduino Nano and to detect the variations in the Power system parameters which may lead to fault. To monitor the current, voltage levels of transmission line to maintain a continuous power supply. To implement the system through hardware prototype where the working model is done using the available active components. Develop a hardware based on the monitoring system where real time measurements can be obtained. Determine the tolerable limit values of voltage, and current. Utilizing the renewable energy can overcome several issues in the environment like environmental pollution, degradation of fossil fuels leading to global warming can be reduced therefore, and the ecological balance and climatic conditions can be maintained. We can supply to GRID also, in case our consumption less and generation is more. In our project we are focusing on the use of renewable energy and building up a hybrid power system with an automatic power monitoring through sensors and controller. Also sensing of parameters such as voltages & current which in turn helps us program to detect faults if any and monitor faults through relay operation. This project focuses much on the efficiency of monitoring process of Hybrid Power System and Fault detection. It aims to build a hybrid power system which is completely reliable on renewable energy sources on the generation side and monitor the power from Solar and Wind energy sources through a DC microgrid implementation. The system is automatic with the use of sensors and controller for monitoring and detecting the possible faults that occur in the DC grid. Faults detected are indicated and in a swift the relay operates protecting the load from possible damage that could occur due to fault.

IV. PROPOSED METHODOLGY

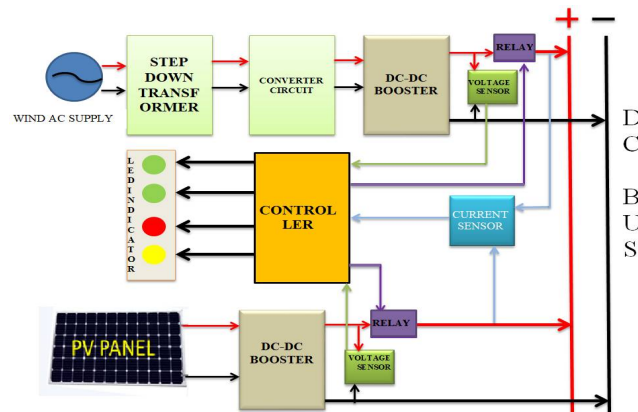


Fig. 1 Block diagram

This project is implemented using microcontroller to make it automatic system. This is main section of project here we are including two sources. Solar panel, Wind section. Solar will work in sunlight and wind will work in air flow. The wind motor output and main supply section output is connected with AC to DC converter for converting into pure DC. DC power from wind section is connected to CN6009 Booster then through relay to DC bus. Similarly, Solar DC output is also connected to CN6009 Booster then through relay to DC bus. We have Voltage divider Circuit individually for both sections whose outputs are given to controller. The controller is connected with Voltage sensors i.e. divider circuit, current sensors on input side and LED indicators, and Relay on its output. With help of this parameter's microcontroller will be able to track availability and fault of source. Based on given code condition the switching will be automatic. For this automatic switching we are writing the code which runs the system, Monitoring of the system with fault detection and Relay operation is carried out. Here is no need to change any wire and no need to press any key. The switching will be automatic based on our code. That code we are writing in Arduino IDE software and based on software we will upload code in Arduino Nano using USB cable. POWER generated FROM WIND section which is an AC supply is connected to Step-down Transformer then to converter circuit. DC power from converter circuit is amplified and given to DC booster then to DC bus through Relay. Power from Solar section through a rechargeable battery to DC booster

and to DC bus through relay. Through voltage divider voltage is sensed in each line separately . ACS712 current sensor senses the current in each line, We have LED strips connected as load to DC bus. Voltage divider output of wind section is connected to A1 pin of Arduino . Voltage divider output of solar section is connected to A0 pin of Arduino . Current sensor output is connected to A3 pin of Arduino. D5 pin of Arduino is given to wind section line relay. D6 pin of Arduino is given to Solar section line relay. D8 pin of Arduino is given to GREEN LED 1. D9 pin of Arduino is given to GREEN LED 2. D10 pin of Arduino is given to RED LED. D11 pin of Arduino is given to YELLOW LED.



Fig.2 Hardware setup

The above figure represents the proposed system hardware kit along with all the components such as Solar and Wind Section, Voltage & Current Sensors, Stepdown transformer, Converter circuit , Arduino Nano, DC DC booster, LED strip (for connecting load) and Relay.

V. RESULTS AND DISCUSSIONS

In this project a prototype of DC nanogrid implementation is done by using components such as arduino nano as controller, voltage sensor through voltage divider method and satisfactory results were obtained.

A. Case 1 : Only Wind supply ON

We have power supply only from wind section and load at dc is bus is on. Indication: only green led 1 will be on

B. Case 2: Only Solar supply ON

We have power supply only from solar section and load at dc is bus is on. Indication: only green led 2 will be on

C. Case 3 : Both Solar & Wind supply ON

We have power supply from both solar & wind section and load at dc is bus is on. Indication: only green led 1 & green led 2 will be on

D. Case 4 : Overcurrent Fault

We have power supply only from solar section and there is over current fault which is due to short circuit or may be due to excessive load. In this case relay of solar will trip and load at dc is bus is off. Indication: Only green led 2 & red led will be on Also solar line relay is in trip condition.

E. Case 5 : Curtailment/ Under Voltage

We have no power supply from both solar & wind section and load at dc is bus is off.

This is due to curtailment or may be due to under voltage

Indication: only green led 1 will be on.

| CASE | INDICATION | RANGE |
|------------------------------|---|-------------------------|
| WIND ON | ONLY GREEN LED 1 ON | 18-24V AT BUS |
| SOLAR ON | ONLY GREEN LED 2 ON | 18-24 V AT BUS |
| BOTH SOLAR AND WIND ON | GREEN LED 1 AND GREEN LED 2 BOTH WILL BE ON | 20-24 V AT BUS |
| OVER CURRENT IN SOLAR LINE | GREEN LED 2 AND RED LED ON | GREATER THAN 1000mah |
| CURTAILMENT OR UNDER VOLTAGE | ONLY YELLOW LED ON | NO VOLTAGE OR BELOW 15V |

Table.1 Result Table

VI. ADVANTAGES

- A. Efficient Utilization of Renewable Energy
- B. No Reactive Power, Hence Higher Transmission Efficiency
- C. No man power required for control
- D. Higher conversion Efficiency
- E. Multi source
- F. Lower Cost converter systems
- G. Easy intergration of various Distributed Energy Resources.

VII. LIMITATIONS

- A. Storage of energy in batteries-their storage & maintainance is a concern
- B. Problemtatic when needs to be Re-synchronized with main grid
- C. Fault detection is Challenging due to high sensitivity to impedance fault
- D. Initial cost may be high and system is not familiar

VIII. CONCLUSION

This Project demonstrates design of a hybrid power system using Solar And Wind as sources of energy which are non-conventional and renewable sources of energy. The generated Power from the sources is converted into a pure DC using suitable Rectifier circuits DC booster etc... The power from two sources are given to a DC Bus which results in a DC Microgrid which find its use in many applications. Power monitoring, Fault detection and relay operation is done automatically in this system through code given to the controller. The objective is completely satisfied, and hardware prototype implementation is successful with suitable results.

IX. FUTURE SCOPE

This project is implementing using microcontroller. Based on multi source the microcontroller will check automatically through connected sensor parameters. But in future we can add many other source in this project. With minimum changes we can increase function in this project and this implementation will increase with effective way in future. An increasing demand for DC Microgrid is seen nowadays and this could be an option in the near future in our Country.

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