Hybrid Renewable Energy Controller for Micro Grid Applications

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Abstract— This paper presents the significance of the deployment of micro grid as a promising aspect in the future of the power systems. During the past decade the use of fossil fuels have multiplied the effects on the global warming. Micro grid is a concept that integrates the Distributed Energy Resources (DER) to form an electric infrastructure that incorporates various renewable energy resources which delivers a cleaner energy generation. It usually consists of multiple distributed sources which are interfaced to the AC grid, such high penetration of distributed generators linked to the grid through controllable power electronic based devices, along with the inclusion of communication techniques, electrical energy storage systems. This enhances the scope of micro grids in electric infrastructure. This paper carries out coordinated analysis of micro grid control strategies, algorithms, and methods of efficient utilization of Renewable Energy Resources (RES) such as Distributed Energy Storage (DES), Photo-voltaic (PV) Generation and loads. Finally, the simulation results under various operations carried out on distributed energy generated, state of charge of Distributed Energy Storage, and basic power management functions.

Key words: Microgrid, DER, Power Management, Energy Storage, Renewable Energy

I. INTRODUCTION

The demand of alternative energy has been favourable due to the crisis of the energy resources i.e., Natural gas, coal, fuel, nuclear energy and etc. Coming to renewable energy, the role of solar energy is very important when compared to others and that is due to the available unlimited energy sources. Nowadays more renewable energy conversion systems are linked to low voltage or AC micro grids due to environmental issue affected by fossil fuel power plant. So AC micro grid is proposed for the connection of renewable power sources to AC systems, and thus fossil fuels requirements are reduced. Reverse conversions required in AC or DC grids may add losses to the system operation and makes the office appliances more complicated. The process of constructing a micro grid is to give high electric power to digital sustainable way. The connection of various AC and DC micro grid systems can facilitate in the advancement of smart grid. In this micro grid project power electronics plays a most important role in this construction. Recently microgrids improves the quality and performance by utilizing battery energy system.

II. RELATED WORK

Various papers have been published on the topic of micro grid they discuss about the concepts and control strategies of micro grid. This method is about hybrid renewable energy sources which is integrated with the micro grid and can be used in powering critical loads. It can provide improved efficiency and reliability for the future power system. The consumption of fossil fuel intensifies the environmental pollution. Hence our micro grid is designed to integrate hybrid renewable energy resources. The micro grid control strategy is designed and simulated by LabVIEW. This is a micro grid concept where existing power transfer method is used. Future developments is carried out in the direction of advancement in micro grid power system.

III. BLOCK DIAGRAM

Fig.1 Shows the Block Diagram of the proposed method. The Block Diagram comprises of three sections. Renewable Energy Section that contains all the hybrid renewable energy resources connected to the micro grid system. Home Section encloses loads, Digital Panel meters and communication equipment. Controller Section is made up of communication devices for receiving data from the nodes of Renewable energy Section and Home Section, these data are processed by MyRIO accordingly and controllers are actuated. Charge controller, charge regulator are also known as battery regulator limits the rate at which electric current is added to the electric batteries. It prevents overcharging and may protect against the over voltage, which can decreases battery performance or lifespan, and may pose a safety risk. Inverter can also be used with transformers to convert the certain DC input voltage into a completely different AC output voltage may be higher or lower but the output power must always be less than the input power. The function of a fuse is to prevent the fire - that's the basic protection of a fuse offers - between power supply and appliance also there may be a few feet or meters of cable.

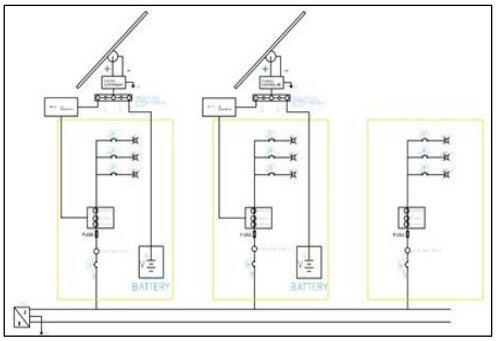

Fig. 1: Block Diagram of proposed Method

The Alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Distribution power systems may be solidly grounded, with one circuit conductor directly connected to an earth grounding electrode system. Alternatively, some amount of electrical impedance may be connected between the distribution system and ground. Relays are necessary when there must be electrical isolation between controlled and control circuits, or when multiple circuits need to be controlled by a single signal.

IV. SIMULATION

The simulation of the hybrid renewable energy micro grid is designed and established using LabVIEW software by National Instruments. The simulation results are obtained for a period of 24 hours and the loads are controlled manually by the user. The designed algorithm suits to the varied operation of the housing loads at various time intervals. The information about the status of electrical systems in the homes are displayed on the digital panel meters. The details such as Watts/hour, Voltage, Current consumed varies accordingly as per Real-Time. Simulation is carried out in various stages and operated simultaneously. The simulation consists of Real-Time Counter, Solar Section, Wind Section, House Section, and Control Panel Section.

A. Real Time Counter

Fig.2 The real time counter is designed with various segment to exhibit the real time characteristics of a 24 hour time-cycle. This aides in the easy understanding of operation of solar renewable energy resources over a course of 24 hours. The solar renewable energy output is variable as it depends according to the irradiance of the Sun's rays.

Fig. 2: Real Time Counter Segment

B. House Section

Fig.3 All the panel reading are real-time according to the simulation timer counter.

1) Power Generated Panel:

The power generated panel is design to display the parameters of generation such as Power generated in Watts/hour, Voltage of the generated power which is maintained at constant using voltage regulator circuitry for minimizing fluctuations in the system, Current according to the load at real-time.

2) Grid Consumption Panel:

This section of the panel meter consists of the details that the power consumed from the existing grid. These values provide the user with information on the cost to be paid according for grid consumption separately.

3) Power Consumed Panel:

This section is designed to provide details about all the real-time electrical parameters of the operations in the house.

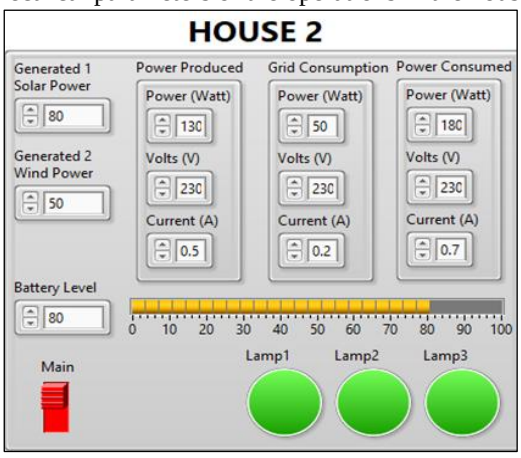

Fig. 3: House Section

4) Generation Section:

In this section the hybrid renewable energy sources that are connected to the micro grid is placed. In this simulation environment we have chosen solar photo-voltaic as the generation source.

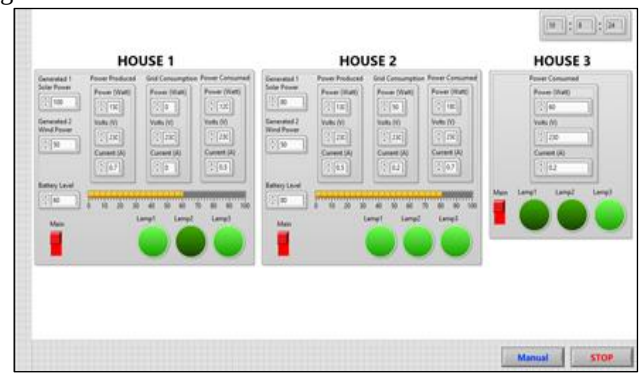

Fig. 4: Simulation of micro grid with all sections

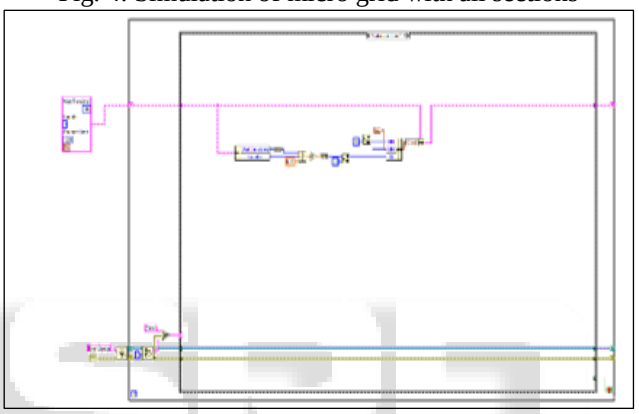

Fig. 5: Real Time Clock Environment block diagram

Thus the micro grid architecture is designed and autonomous control strategies are in place which makes the operations, control, and communications in the micro grid. This micro grid is designed and simulated successfully in the LabVIEW.

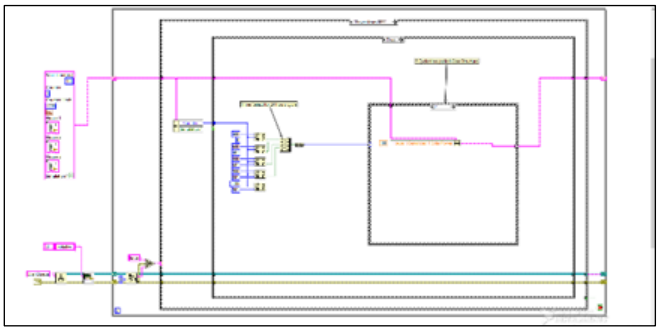

Fig. 6: Renewable Energy Section block diagram

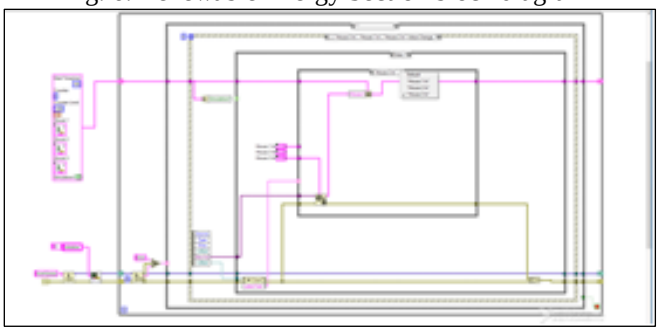

Fig. 7: House Section block diagram

Thus the micro grid architecture is designed and autonomous control strategies are in place which makes the operations, control, and communications in the micro grid. This micro grid is designed and simulated successfully in the LabVIEW. The micro grid architecture enhances the reliability of the renewable energy resources integration into the electric infrastructure thereby decreasing the reliance on the existing grid infrastructure and moving towards a greener energy.

V. CONCLUSION

Thus the micro grid architecture is designed and autonomous control strategies are in place which makes the operations, control, and communications in the micro grid. This micro grid is designed and simulated successfully in the LabVIEW. Thus the micro grid architecture is designed and autonomous control strategies are in place which makes the operations, control, and communications in the micro grid. This micro grid is designed and simulated successfully in the LabVIEW. The micro grid architecture enhances the reliability of the renewable energy resources integration into the electric infrastructure thereby decreasing the reliance on the existing grid infrastructure and moving towards a greener energy.

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