

Design and Development of Solar & Wind Renewable Energy System

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Abstract

The environmental pollution is a major concern today as the contaminants are introduced into the natural environment. This, in turn causes the adverse change the environment leading to hazardous cause on human life and others. Further, the effect of the pollution is irreversible. Environmental issues can be resolved through a controlled process or through a use the natural process. The use of fossil fuels and industrialization is another factor which leads to environmental pollution.

The current work on Design and development of Hybrid Renewable Energy System is the possible solution to provide a continuous energy to the users. This work is based on the two renewable energy resources namely, solar and wind. The proposed solution utilizes a 20W solar panel and a wind turbine with maximum output of 35W. The whole system is governed and controlled by the centralized controller developed using Peripheral Interface Controller PIC16F877A.

The Hybrid system has voltage and current measurement features to monitor the generation of the power from solar, wind and the amount of power consumed at the user end. The System is a standalone system which can supply both DC and AC load. The system has an inverter as one of its subsystem at the load side to invert DC power into AC power. System has a display system to monitor the electrical parameters such as solar voltage,

solar current, wind voltage, wind current, load voltage and load current.

Over above, system shows the solar power, wind power, the power delivered to the load. Thus the proposed system is complete solution of hybrid renewable energy system with all features of control and monitoring.

Keywords: *Renewable energy, Hybrid, Wind generation, Wind turbine*

INTRODUCTION

Electricity is one of the key factors on which the economy of the country depends. Therefore the sustainable power generations with economically feasible solutions are the key factors for the growth of the country. Presently many parts of the world use fossil fuels for the generation of power but these resources are depleting fast is the cause for the concern. Due to environmental pollution, Fossil fuel based power generation is slowly being backtracked.

Hence the alternative energy resources are the need of the hour. The alternative energy resources which are now researched much are renewable energy resources namely solar, wind and so on. They are fast finding their ground in many parts of the world due to their non-pollution features.

LITERATURE SURVEY

A survey on these renewable energy

resources is presented in [1]. The survey reveals that these renewable systems are not economically viable due to their high initial cost. Nevertheless, the need for greener power generation is the need of the hour. These solutions are most needed in rural and remote areas where utility power is the distant dream. A hybrid solar and wind power generation system for the rural application has been presented in [2]. The regulation and control of the generated power is not considered by the proposed system. This has the direct effect on the efficiency of the system. A brushless DC permanent magnet generator based wind system is presented in [3]. A Simulink/Matlab model has been developed to study the power generation of the proposed system at different wind speeds. But the implementation of the proposed work wasn't developed to confirm. Another survey carried out and presented in [4] by focusing on wind, solar, micro hybrid, biomass, FC and tidal source. Study has indicated that the wind

renewable system has the most potential worldwide. Many industrial applications need power at various levels. The feasibility and applicability study of renewable energy power sources to these applications is presented in [5].

Hybrid Energy System

The hybrid means, is the combination of two or more than two renewable energy sources. In energy system the electricity can be generated by more than one source at a time like Wind, solar. There are various modules used to generate hybrid energy, for examples, wind-solar hybrid, Solar-diesel, Wind- hydro and Wind–diesel.

Photo-Voltaic (PV) Solar

PV is the most promising materials in nowadays; it is one of the commonly used renewable energy sources for the grid power system. Solar panels are the medium to convert solar power in to electrical power. Combination of several solar cells design is said to be solar module and it is also an weather proof unit. Incident light is absorbed by solar cell which is diode and it is converted and it is converted into electricity. Physically and electrically connected solar modules will give rise of solar panels. Energy

consumption must be estimated to determine the size of PV modules.

Wind Energy

Wind power is the use of an air flow throughout the wind turbine to mechanically generate power for electric power. Wind power is used, as an alternative of burning fossil fuels, is enormous, renewable, widely distributed, clean and no production of greenhouse gas emissions during operation, consumes no additional source and uses little land.

3SPECIFICATIONS OF THIS HYBRID SYSTEM

Specifications:

The proposed system consists of a solar source and wind source to form a hybrid system. The details are presented in following sections.

- a)** Controller
- b)** Sensor
- c)** Inverter
- d)** DC-DC converter
- e)** Microcontroller
- f)** LCD
- g)** Battery

DESIGN OF HYBRID ENERGY

Hardware design is divided into number of blocks, which are presented in the

following sections.

DC-DC Converter

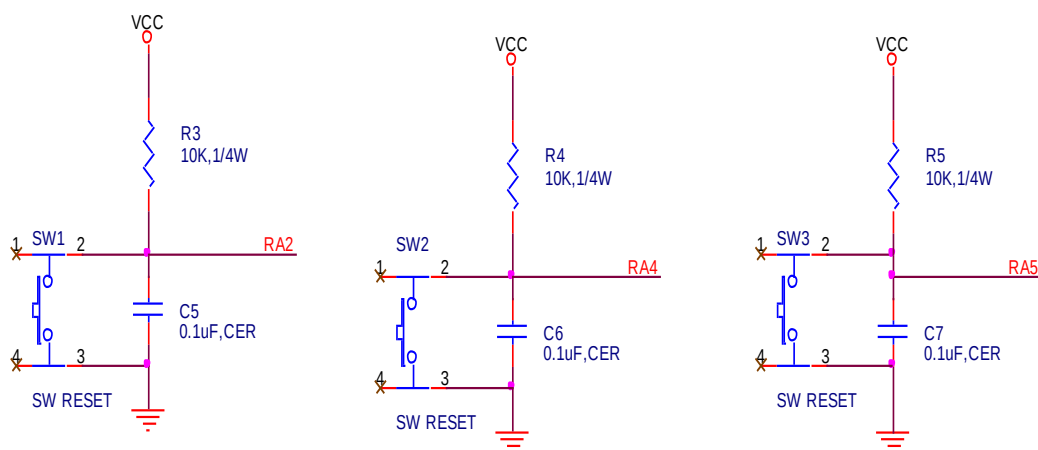
The low drop out regulator, LM317 is used to design the dc-dc converter. It is a buck converter as it converts 12V DC into 5V DC. It is an adjustable output regulator, where the resistor divider circuit is used to set the output voltage.

Microcontroller Circuit

The microcontroller circuit is PIC16F877A, an 8 bit-microcontroller from Microchip Semiconductor Company is used in this project. It is a 40 pin device has 4 general purpose ports and all pins can be used as general purpose input /output pins. It has built in 10 bit ADC

which can be used to convert analog signal to digital signal. The microcontroller is capable of working from 4MHz – 20 MHz clock. In this application 20 MHz clock is used. The reset circuit consists of $R1=47k$ & $C4=0.1\mu F$ and a push button switch. The microcontroller is programmed through In Circuit Serial Programming method. In this circuit two I/O pins viz, AN0, AN1 are used as ADC inputs to acquire battery voltage and current sensor data. The port 'D' is used as a data bus to exchange data between Liquid Crystal Display (LCD).

Key Pad Circuit



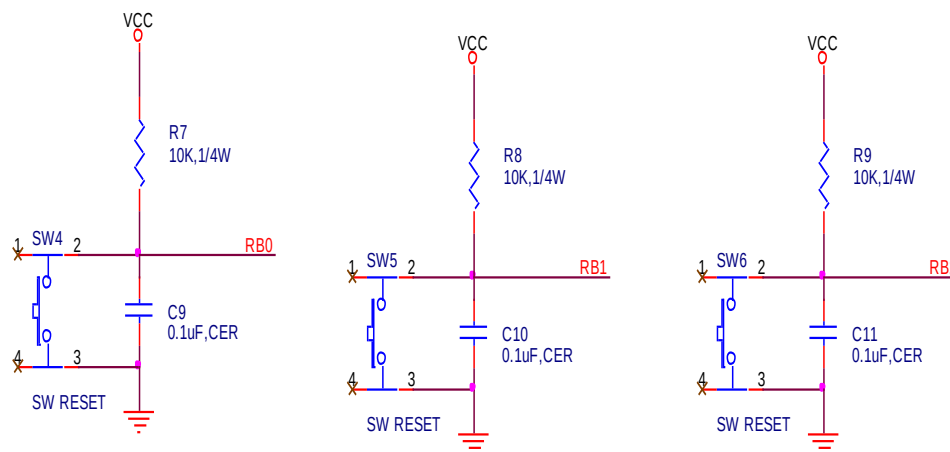


Figure 1: Key Pad Circuit

The key pad circuit used to implement the push button switches to select various options such as Temperature, Weight, BP/Pulse etc. The $R=10k$ & $C=0.1\mu F$ combination is used to provide de-bounce the switch action. SW1-SW6 are the 6 push button switches mounted on a general printed circuit board to create key pad.

SIGNAL CONDITIONING CIRCUIT FOR CURRENT SENSOR

Pass filter using RC combination. The output of this buffer is limited to 5V by means of a 5.1v Zener diode. the signal conditioning circuit for current sensor ACS712-30A. The circuit is designed using LM358 and is configured as buffer and a low This protects the microcontroller I/O pin from any damage that can happen due to higher voltage appearing at the output of the buffer amplifier.

5. SIGNAL CONDITIONING CIRCUIT FOR BATTERY VOLTAGE SENSING

The signal conditioning circuit for battery voltage sensing, the circuit is designed using LM358 and is configured as buffer and a low pass filter using RC combination. The output of this buffer is limited to 5V by means of a 5.1v Zener diode. This protects the microcontroller I/O pin from any damage that can happen due to higher voltage appearing at the output of the buffer amplifier.

LCD Interface

The 2 x 16 character LCD display is interfaced with the microcontroller to display the parameters acquired from various sensors is shown in figure-4.6 above. The potentiometer (POT) is used to adjust the contrast of the display.

SIMULATION RESULT

Solar panel

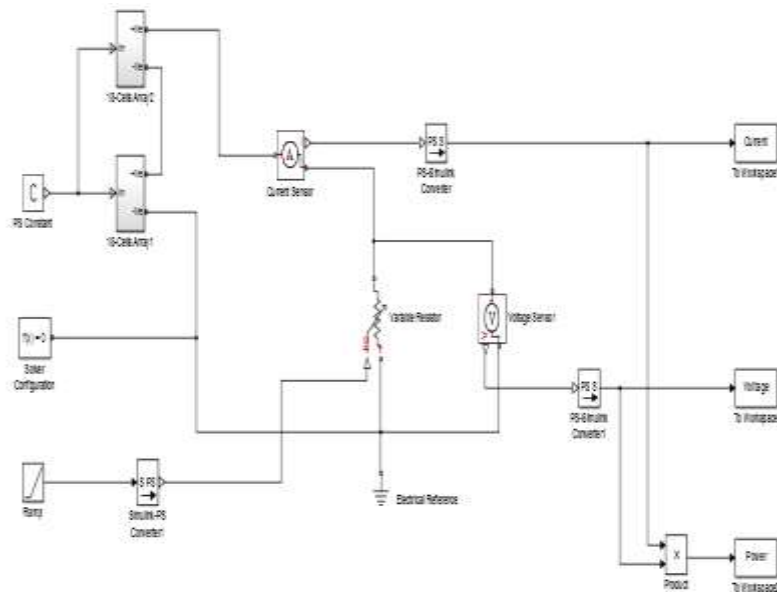


Figure2: simulation of solar panel

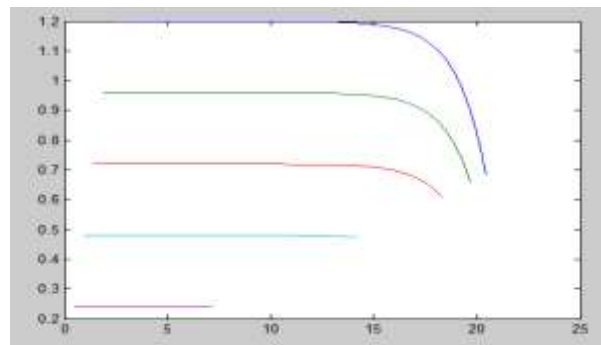


Figure 3: Voltage v/s Current characteristics

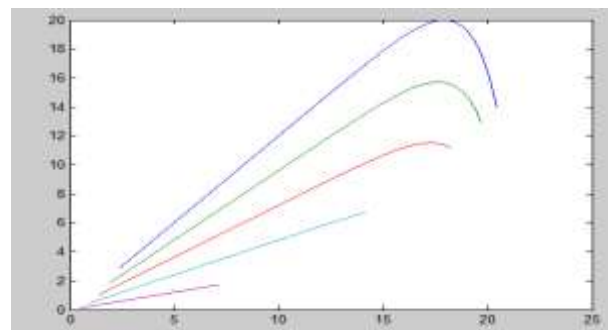


Figure 4: Voltage V/s Power characteristics

Wind Turbine

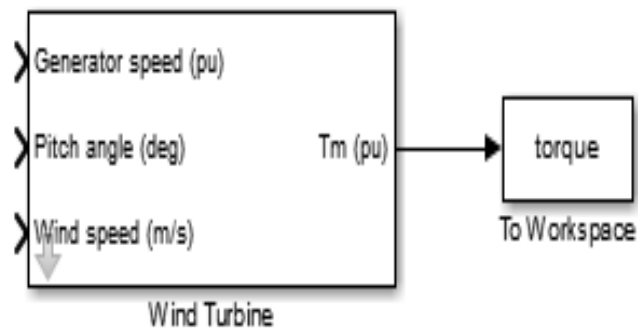


Figure 5: simulation model of wind generator

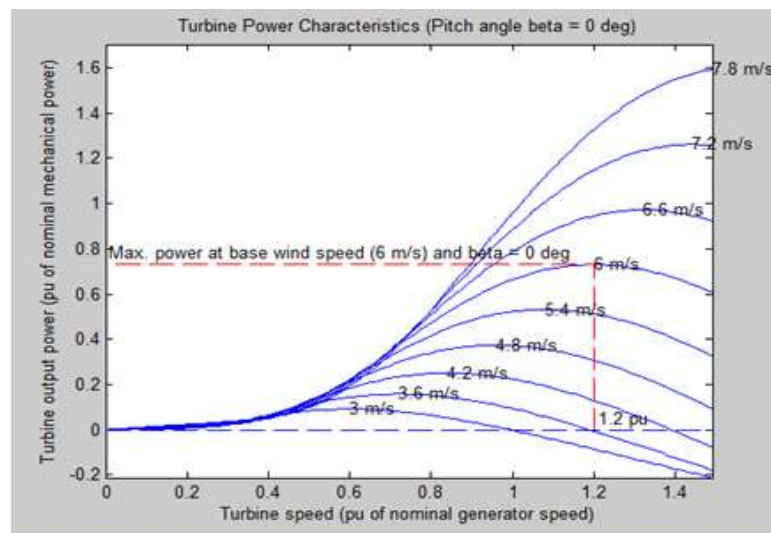


Figure 6: Characteristics

Source router

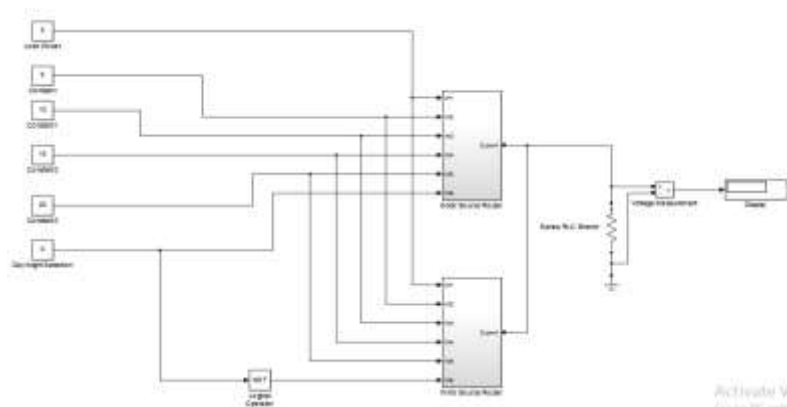


Figure 7: simulation of Source router

Buck converter

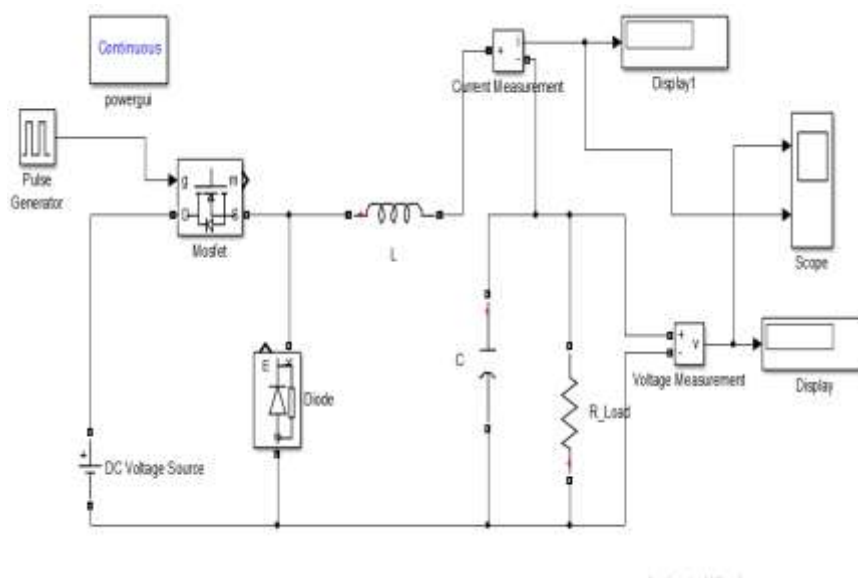


Figure8: Simulation of Buck converter

CONCLUSION

The proposed hybrid renewable energy system consisting of solar source and wind source has been developed. The performance of the system was tested with both DC and AC loads. The results show that the developed system works well with both DC load and AC load. The proposed system can be utilized for domestic, industrial applications with higher rating. The proposed and developed system is of lower capacity and is used as a proof of concept.

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