DUAL POWER GENERATION USING SOLAR AND WIND FOR THE UTILIZATION OF HOME APPLIANCES

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Abstract - Wind and Solar power are becoming the alternative energies sources more popular in India, due to their abundance, availability and ease to obtain electric power from renewable resources. This paper covers the construction of a dual renewable energy system for house applications, which uses simple materials for its construction and implementation. This system includes rechargeable batteries, which ones are charged by wind power via a DC alternator and/or solar power via solar cells, both use a maximum power point tracking (MPPT) module. This energy system has been designed for low power consumption by its simplicity. The aim of this work is to design and implementation of a solar-wind dual energy system using a simple design, for example, we adapted a simple DC motor for wind generation. This work is expected to sustain some part of the daily domestic electricity consumption with an efficient utilization of solar and wind power.

Keywords— Solar energy, wind energy, MPPT controller,

I. INTRODUCTION

We already know that generating electricity with a single power source non-conventional energy does not supply electricity required for average consumption house and a lot least one building. Renewable energy sources as solar, wind, geothermal, tidal, hydro etc. are inexhaustible by nature. So, renewable energy sources can be used to provide constant loads. There are number of technological developments in design, construction and implementation for generating electrical energy by using non-conventional sources as solar, wind, hydro, biomass, bio fuels and geothermal. The limitations of global resources for fossil and nuclear fuel, has necessitated an urgent search for alternative sources of energy since they are going to exhaust soon. So here Solar and wind energy sources are used to reduce the global warming. These renewable energies becoming more important and pollution free. The need of clean energy generation with less environmental impact is required. Solar and wind energy system is highly unreliable due to their unpredictable nature. Due to environmental or day-night situations the output of these two energy resources is not certain, that one might give more power and other might give less power or no power. To obtain stabilized voltage output from these two systems, connection of these two systems is in parallel to each other, so that if one source is not available, then the other one can balance the system. Thus, these two systems can work individually and simultaneously too.

II. DUAL POWER GENERATION SYSTEM METHODOLOGY

The general dual power generation system mainly consists of three stages:

A. Power Generation Stage
B. Converter / Controller Stage
C. Output Stage

A. Power Generation Stage

Power is generated using wind energy, solar energy or combination of both in power generation stage.

1) Solar Energy - The term Solar Power or Solar Energy is the radiant energy emitted by the Sun. Radiant light and heat energy emitted from Sun is form of solar energy which is used in many technologies such as solar heating and photovoltaic. Photovoltaic cell converts light energy in to electric energy or current by using the photoelectric effect. Photovoltaic cell is also known as Solar cell is a device which converts light energy in to electrical energy from sunlight. Solar panels or PV module are made up of number of Solar cells. The output of PV module is related ambient temperature and solar radiation. Solar panels used in solar power systems are available as readymade by manufacturers. Solar panel is at STC condition of 25 □ C temperatures and irradiance value of 1000 W/m².

2) Wind Energy - Wind energy is a part of renewable energy system. Wind turbines are used to converts kinetic energy of wind into mechanical energy for generator, which converts mechanical energy into electricity. Wind turbines of wind energy systems are connected to gear box. The gear box has the electrical- mechanical interface. The output of the gear box is given to the Permanent Magnet Direct Current Motor (PMDC), which produces DC output.

3) Solar-Wind Dual Energy System - Dual power system combines solar and wind energy. The dua system is combination of photovoltaic (PV) array, wind turbine. Dual power system has several advantages over single system. In dual power system output of solar and wind energy system are added together in parallel in order to compensate absence of any one energy system. Solar and wind energy system can work individually or together. The block diagram of developed model of solar and wind dual energy system has given.

B. Conversion/ Controller stage

The two energy sources, solar and wind energy are used as input. Solar energy system gives DC voltage at the output. Wind energy system also gives DC voltage at the output. Then the output's of both the form is combined and fed into the controller which controls the input voltage an ives the constant voltage at output side. The parameters like voltage, current, maximum power and also the remaining charge or power in the battery can also be displayed in the LCD. For the sensing of current we use an Current sensor (ACS712).

1) Maximum Power Point Tracking (MPPT)

When a solar PV module is used in the input side of the hybrid system, the operating point is decided by the load. The solar radiation varies throughout the day, so operating point changes respectively. A special method called Maximum Power Point Tracking (MPPT) is used for maximum power transfer at the output side. Maximum Power Point Tracking uses the algorithm and an electronic circuitry. Maximum power point (MPP) is extracted from the renewable source i.e., solar and wind energy. The output power of the solar module is input to the algorithm. Maximum power point tracking (MPPT) used increases the efficiency of solar photovoltaic (SPV) system. The proposed machine has the prominent advantages of high reliability[6]. The MPPT demands speed control which is realized using vector control of the rotor side converter.

2) Algorithm for MPPT

There are various types of schemes in algorithm of MPPT that are implemented for maximum power transfer. The schemes are hill climbing method, incremental conductance method, constant voltage method, modified hill climbing method, system oscillation method and ripple correlation method. The constant voltage method is used in this methodology for MPPT.

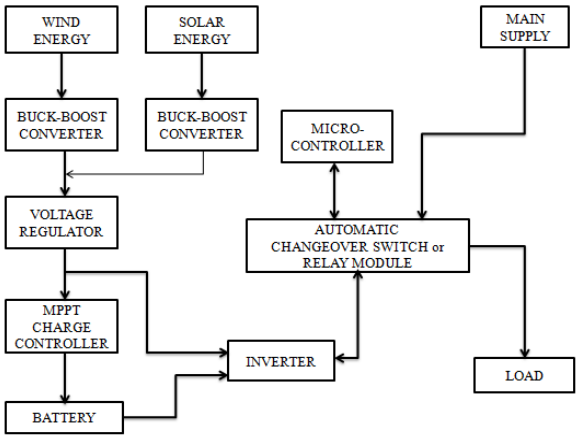
3) Constant Voltage Method

The ratio of PV module array voltage and an open circuit voltage is nearly constant, independent of any external conditions is known as constant voltage method. The sensed PV array voltage is compared with the reference voltage to generate an error signal, which controls the duty cycles.

C. Output Stage

The controller gives the constant output voltage irrespective of any input voltage to the MOSFET driver circuitry. At the output side MOSFET driver circuitry gives the voltage to charge the Battery. It consists of main and auxiliary battery storage system which has higher energy yield as compared to conventional energy storage system.

BLOCK DIAGRAM



COMPONENTS

SOLAR PANEL

- Solar panels are photovoltaic which, generates electrical energy using sun light radiations. Depending on the position and intensity of the sun radiation the amount of electrical DC energy will produced.
- For this proposed project specifications and design, a two 45 watt solar panel is used.

SPECIFICATIONS:

- Maximum(Pm) - 45Wp
- Open Circuit Voltage(Voc) – 21.5V
- Short Circuit Current(Isc) – 2.90A
- Rated Voltage(Vm) – 18.1V
- Rated Current(Im) – 2.50A
- Output Tolerance - ±5%

WIND GENERATION

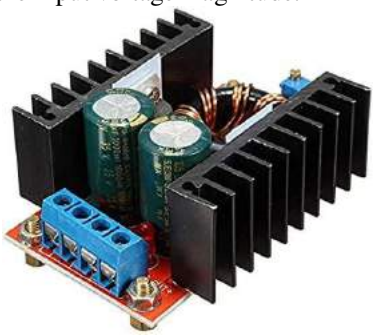
- Wind Turbine is a mechanical system/machine which generates electrical energy from renewable wind energy source.
- Depending on the speed of the wind the amount of electrical DC energy will be produced. For this project, we use 120W DC Motor.

SPECIFICATIONS:

- Rated Voltage - 12V
- Maximum Power - 120W
- No load current - < 0.55A
- Rated current - < 7.0A
- Torque - 0.45Nm
- Efficiency - >70%
- Speed - 3350RPM

BUCK BOOST CONVERTER

The buck–boost converter is a type of variable DC – constant DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude.



SPECIFICATIONS:

a) Input – 12V
b) Output – (14-35)V
c) Efficiency – 94%
d) Operating Temperature – (-40ºC to 85ºC)

CURRENT SENSOR

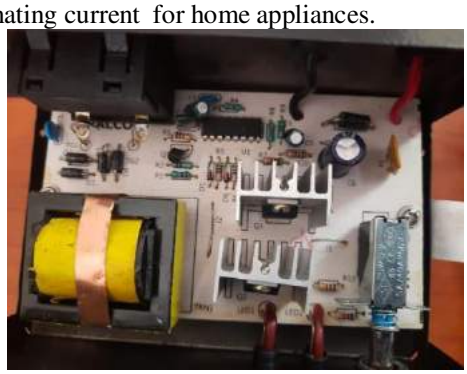
- ACS712 sensor, which can accurately detect AC or DC current. In this project we use this to find the load current.
- The maximum AC or DC that can be detected can reach 5A and the present current signal can be read via analog I / O port of Arduino.

SPECIFICATIONS:

- Supply Voltage: 4.5V~5.5V DC
- Measure Current Range: -5A~ 5A
- Sensitivity:180mV/A ~190mV/A, Typical: 185mV/A

INVERTER

- An inverter is an electronic device that converts direct current (DC) into alternating current (AC).
- Direct current is produced by devices such as solar panels, wind generation & batteries when connected an inverter to it we can use the output alternating current for home appliances.



BATTERY

- The electrical energy produced by the system is need to be either utilized completely or stored.
- Batteries is the most relevant, low cost, maximum efficient storage of electrical energy in the form of chemical reaction. Hence, batteries are preferred.

SPECIFICATIONS:

- Capacity – 12V, 7Ah
- Charging Current – 1.8A
- Charging time – 4.5hrs

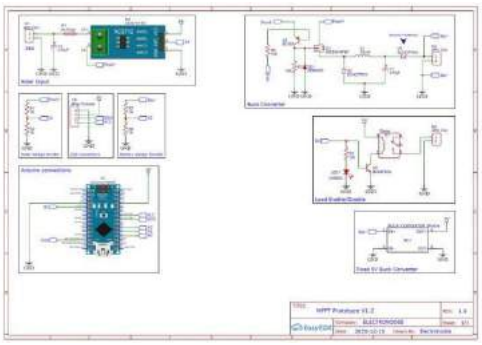
ARDUINO UNO

- Arduino is an open-source electronics platform based on easy-to-use hardware and software.
- Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

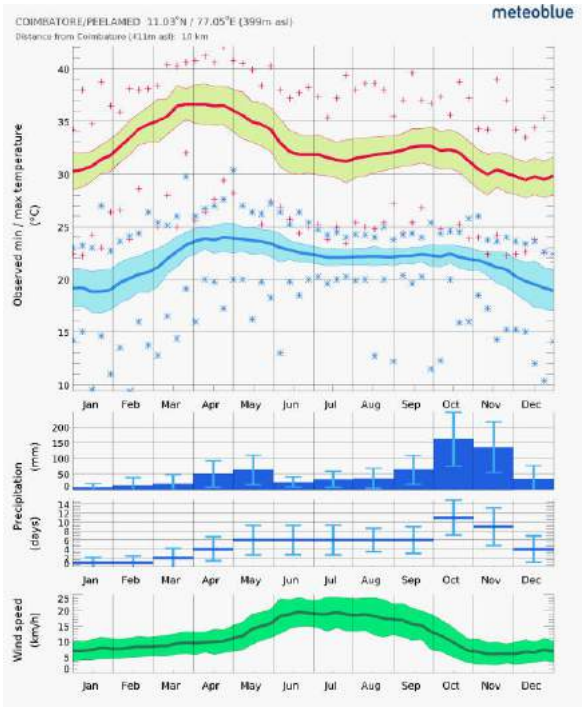
SPECIFICATIONS:

- Operating voltage - 5V
- Digital input/output pins - 14
- Analog i/p pins - 6
- DC Current for each input/output pin - 40 mA
- DC Current for 3.3V Pin - 50 mA
- Flash Memory is 32 KB

SCHEMATIC DIAGRAM



SURVEY OF TEMPERATURE & WIND AT COIMBATORE



WORKING

In this project we use the 45W solar panel with the voltage rating of 20.6Volt and current rating of 2A. By connecting two panels in parallel configuration we can increase the current value. Then the output voltage from the panel is fed into the boost converter to step-up the voltage to above 48Volt and then to buck-converter to step-down to 12Volt.

For wind energy generation we use 12Volt Permanent Magnet Direct Current (PMDC) Motor which can produce up to 5Amps of current. The output from DC motor is also connected to boost the output voltage up to 30Volts then given to buck converter to step down the voltage to 12Volt.

The reason for using buck boost converter is to reduce the voltage losses and to stabilize output voltage from wind and solar energy. Hence the output voltages from two different forms are synchronized.

Then the output voltage is fed into MPPT controller with the help of diodes which can prevent the circuit or components from return current damages. The MPPT controller is used to store the harvested energies from wind and solar in the batteries for later use.

The battery has a charging voltage of 13.5Volt in standby mode and 14.7Volt in cyclic mode. The mode of charging is chosen and controlled by the controller i.e., Arduino. Once the battery is fully charged with the help of the relay module and Arduino the battery has been cut off from the MPPT charge controller to protect the battery from over charging.

The relay is triggered by sending PWM signal from the Arduino. It can be also used to switch

the supply of the load between the main supply and renewable energy and vice versa.

OUTPUT TABULATION:

S.No	Time Period	Solar Output		
		Voc(V)	Isc(A)	P(W)
1	09:00-11:00	19	3	57
2	11:00-13:00	21	4	82
3	13:00-15:00	22	6	132
4	15:00-17:00	18	2	36

ADVANTAGES

- You can switch the power between the supply or battery either by your own or automatic.
- Less expensive than a complete stand alone system.
- The system can be switched easily between on-grid & off-grid system.
- Longer life and No pollution.
- Small wind electric systems can lower your electricity bills by 50%–90%.
- Help you to avoid the high costs of having utility power lines extended to a remote location.

APPLICATIONS

- It can be used as an emergency power backup at power shutdown situations.
- It can be used to charge the E-Vehicles without consuming power from EB.
- Remote & rural village electrification
- Street lighting, Traffic signals.

CONCLUSION

There is the need of an alternative sustainable electric power supply system to provide electricity to rural and the unreached communities. The provision of dual solar -wind energy system to power banking and hospitals in rural and the unreached communities that are not connected to National Grid Power supply system is very important so as to maintain a continuous electricity supply. When considering the cost and overall efficiency, it is advisable for all the stakeholders who have concern for the rural community development to embrace solar and wind power.

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