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Implementation of Vertical Axis Wind Turbine using Permanent Magnet Synchronous Generator

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ABSTRACT

This project studied the potential for installing roof-mounted vertical axis wind turbine (VAWT) systems on house roofs.

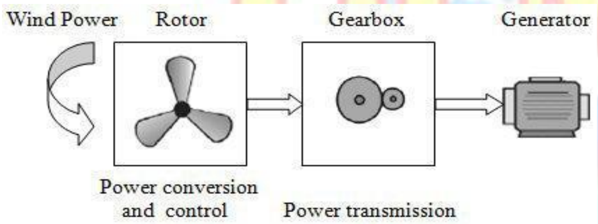
The project designed several types of VAWT blades with the goal of maximizing the efficiency of a shrouded turbine. An RPM meter and a 48V PMSG were used to measure turbine rotation speeds and power output at different wind speeds. The project also studied roof mounting systems for turbines that are meant to dissipate vibrations to the roof structure. Recommendations were made for future designs of roof-mounted VAWTs. In this model we are using DC-DC boost converter to stepup the output voltage from the output of VAWT is given to converter.

I. INTRODUCTION

When If the efficiency of a wind turbine is increased, then more power can be generated decreasing the need for expensive power generators that cause pollution. This would also reduce the cost of power for the common people. The wind is literally there for the takingand doesn't cost any money. Power can be generated 0and stored by a wind turbine with little or no pollution. If the efficiency of the common wind turbine is improved and widespread, the common people can cut back on their power costs immensely. Ever since the Seventh Century people have been utilizing the wind to make their lives easier. Windmills have 5-6 blades. While past windmills have had 48 blades. Past windmill also had to be manually directed into the Low Expense Vertical Axis Wind Turbine Using Permanent Magnets Generator. The saildesign and materials used to create them have also changed over the years. In most cases the altitude of the rotor is directly proportional to its efficiency. Actually there are two types of windmills (the horizontal axis windmills and the vertical axis windmills). The horizontal axis windmills have a horizontal rotor much like the classic Dutch four-arm wind-mill. The horizontal axis windmills primarily rely on lift from the wind.

As stated in Bernoulli's Principle, "a fluid will travel from an area of higher pressure to an area of lower pressure. It also states, "As the velocity of a fluid increases, its density decreases." Based upon this principle, horizontal axis windmill blades havebeen designed much like the wings of anairplane, with a curved top. This designincreases the velocity of the air on top of theblade thus decreasing its density andcausing the air on the bottom of the blade togo towards the top. Creating lift .Theblades are angled on the axis as to utilize thelift in the rotation. The blades on modernwind turbines are designed for maximum liftand minimal drag. Vertical axis windmills,such as the Durries (built in 1930) use draginstead of lift. Drag is resistance to the wind,like a brick wall. The blades on vertical axiswindmills are designed to give resistance tothe wind and are as a result pushed by thewind. There have been many improvementsto the windmill over the years. Windmillshave been equippedwith air breaks, tocontrol speed in strong winds. Some vertical axis windmills haveevenbeen equippedwith hinged blades to avoid the stresses athigh wind speeds. Some windmills, like thecyclo- turbine, have been equipped with avane that senses wind direction and causes the rotor to rotate into the wind.Windturbine generators have been equipped withgearboxes to control [shaft] speeds. Wind turbines have alsobeen equipped withgenerators which convert shaft power into electrical power. Many ofthesails onwindmills have also been replaced with propeller- like aerofoils. Some wind millscan also stall in the wind to control windspeed. But above all of these improvements,the most important improvement to thewindmill was made in 1745 when the fantailwas Invented. The wind speed is measuredby ananemometer.

BLOCK DIAGRAM OF WIND POWER GENERATION



CLASSIFICATION OF WIND TURBINE

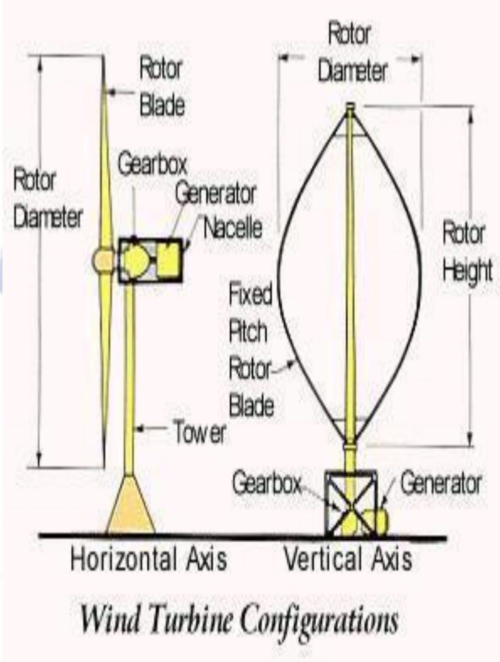
Wind turbine’s are classified into two type’s Horizontal axis and Vertical axis wind turbines (HAWT and VAWT).

HORIZONTAL AXIS WIND TURBINE**:** The horizontal axis wind turbines arethe most common and have blades rotate on an axis parallel to the ground.

VERTICAL AXIS WIND TURBINE:

Vertical-axis wind turbines (VAWTs e atype of wind turbine wherethe main rotor shaft is set vertically. Among the advantages of thisarrangement are that generators and gearboxes can be placed close to the ground, and that VAWTs do not need to be pointed into the wind, Majordrawbacks for the early designs (Savonius, Darrieus).

The blades on a vertical axis wind turbine can utilize an airfoil design like the VAWT; however a VAWT can also use blades that directly face



PROPOSED DIAGRAM OF VAWT

BLADE:

In VAWT,the blades are made up of Aluminium sheet.It consists of 3blades in parabolic shape.

TOWER :

In VAWT, the tower are madeup of steel

BEARING:

The requirement of 2 pedestal bearings that are going to primarily centralize the shaft, and bearingto take the majority of the weight. This combination will provide the least amount of friction, while maximizing bearing life and maintaining safe operating conditions

PERMANENT MAGNET GENERATOR:

permanent magnet alternator (also called PMA, permanent magnet generator, PMG or magneto) relies on the magnetic field generated by a permanent magnet to convert mechanical energy into electrical power. It can generate AC current, with which it can power the whole engine and charge the battery.In this article we will focus on the typical structure of a permanent magnet structure and also give a brief introduction to its working principle.

A modern alternator contains both moving and stationary coils of wire. In the alternator, however, the moving coil, called the rotor, uses current supplied through slip rings to generate a moving field. Power is extracted from the stationary field coils.

•The stator contains six coils of copper wire cast in fiberglass resin. It is mounted onto the spine and does not move.

•The magnet rotors are mounted on bearings turning on the shaft. There're two rotors: the rear one behind the stator and the front one on the outside, which are connected by the long studs passing through a hole in the stator.

The blades are mounted on the same studs. They will drive the magnet rotors to rotate and move through the coils. During this process electric power is produced.

•The rectifier is mounted on an aluminum “heatsink” to keep cool. The copper wire transfers the generated electricity to the rectifier, which works to change the AC to DC for battery charging.

PROPOSED BLOCK DIAGRAM OF DC-DC BOOST CONVERTER BOO ST CONVERTER

Working Theory

A boost converter or a voltage stepped up converter is a DC-DC converter with yield voltage enhanced contrasted with enters. It is sort of exchanged mode power supplied or SMPS that holds at any rate a diode and a transistor and in any event a vitality putting away component like capacitor, inductor, or the two together. synthesis with inductors have been added to converter yield to lessen yield voltage swell.

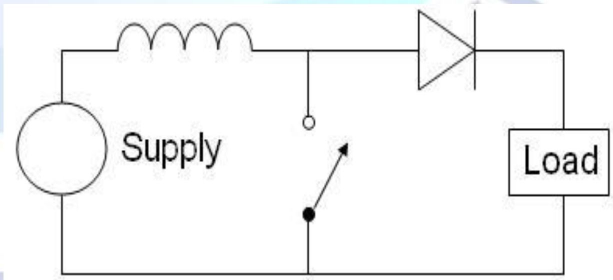


Figure Boost Converter Schematics

Circuit Analysis

The important standard that works the boost converter has been the propensity of the inductor to oppose variations in present by making and pulverizing an attractive field. In this converter, the yield voltage is constantly greater than the voltage inputted. A circuit of boost force stage is demonstrated.

(a) If switch is shut, electric current courses from the inductor in direction of clock are course and the inductor acts a store to some vitality in producing an attractive field. Extremity in the lifter side of the inductor is sure.

If switch is in open position, current shall be lessened due to higher impedance. The attractive field at one time made will be devastated to keep up current stream towards the heap. SubsequentlyOn and off chance that the switch is cycled quickly enough, the inductor won't release completely in the middle of charge stages, the heap would dependably have a voltage more prominent than pertaining to only the source if the switch is open. Likewise if the switch is open, the capacitor parallel to the heap is charged to joined potential. At this point when the switch is shut and the right side is short circuited from left side, capacitor is subsequently fit in giving potential difference and vitality to the heap. Throughout this time, the blocker diode keeps the capacitor against releasing from the switch. The switch should obviously be opened and quickly to keep the capacitor to release excessively.

The fundamental guideline of boost converter comprises of two unique states. The On-state, in which the switch is shut, bringing about on expand in the current through inductor. Switch is non-conducting in off state and the main way leading to current in inductor from the diode, and capacitor and the heap. This leads to exchanging of the vitality amassed in the capacitor throughout the switching on state

MODELING OF SINGLE INPUT DUAL OUTPUT (SIDO) BOOST CONVERTER

The Single Input Dual Output (SIDO) Boost converter used to achieve two regulated output voltage. In conventionalmethod Single Inductor Dual output (SIDO) Buck converter, two buck converter connected in parallel with independently control the output voltage. Normally the two paralleled buck converter required two switching devices and freewheeling diodes. The two freewheeling diodes eliminated by introducing two power switches [1].In conventional method one power switch eliminated [2],and one Inductor used. The output voltage is less than the input voltage. The control circuit design also complicated. In proposed method Input source is VAWT system. The Single Input Dual Output Boost converter used to get two different increased voltages from VAWT . In proposed method, two normal boost converters connected in parallel. In conventional method three power switches used, but the cost of power switch and its power circuitry cost also high compare than normal parallel buck converter. In proposed method one control switch is reduced compared than conventional method, so the switching loss and control circuitry cost also reduced. The output voltage of VAWT is very low. Boost converter improve the output voltage. In proposed method two regulated boost dc voltage achieved from VAWT. Closed loop control used to achieve required output voltage. The proposed method control design is simple than the conventional method.

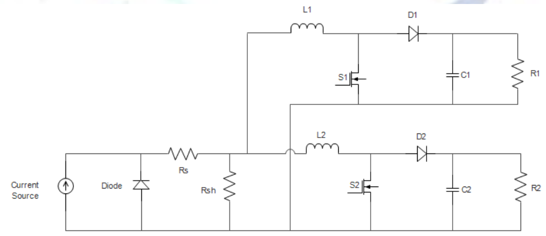


Figure Circuit diagram of SIDO Boost converter

A boost converter (step-up converter) is a power converter with an output DC voltage greater than its input DC voltage. It is a class of switching-mode power supply (SMPS)containing at least two semiconductor switches (a diode and a transistor) and at least one energy storage element. Filters made of capacitors (sometimes in combination with inductors) are normally added to the output of the converter to reduce output voltage ripple.

Operating principle

The key principle that drives the boost converter is the tendency of an inductor to resist changes in current. When being charged it acts as a load and absorbs energy (somewhat like a resistor);

MODES OF OPERATION

Mode 1

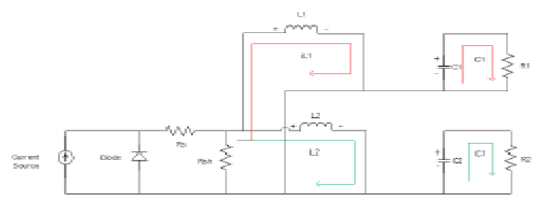


Figure Circuit diagram of mode 1

When the MOSFET switches S1 and S2 ON (closed), the whole circuit will be divided into two loops one at the output side and another at the input side. The closed loop at input consisting of inductor gets charged by the current flowing through the loop during period. This current will increase linearly till the time the switch is in closed condition. In the same time interval, inductor voltage is also high as it not delivered to any load but to itself. Diode is off during this mode. The equivalent circuit representation of mode 1 is shown in Figure

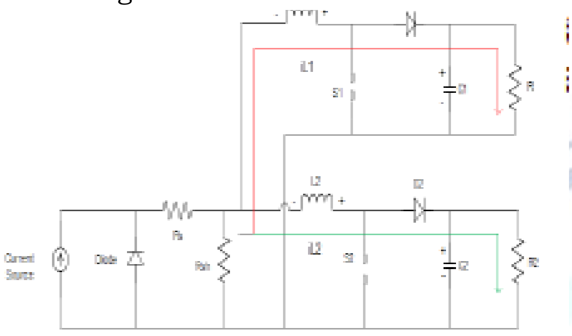


Figure Circuit diagram of mode 2.

When the switch S1 and S2 is in OFF state (open).there will be closed loop consisting of power source, inductor and RC load. The energy stored in inductor durin ON state is discharged to RC load circu through the diode. Thus inductor current reducing linearly, charging the capacitor the load side. The equivalent circuit fc mode 2 shown in Figure

Thus for closed switch time inductor gets charged and capacitor is delivering the

required power to the load, and for the opened switch time inductor will discharge supplying the full power to load and charging capacitor simultaneously.

Input Voltage

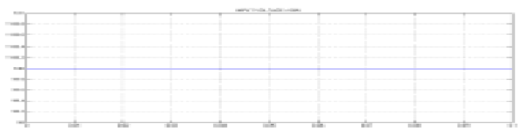


Figure 4.2 Vin (V) vs. Time (Sec)

shows existing system SIDO buck converter input voltage. it given by using dc power source (Vin=100V)

Output Voltage

CONCLUSION

This section describes the results of our testing and shows how we compared oursplit Savonius design with the previous 4 flat bladed design and airfoil designs. The resultsalso address the use of having funnels attached to shrouds, in hope of increasing poweroutput. Lastly, the results will show the analysis of the vibration testing performed on themodel house.

A new Single Input Dual Output Boost converter is presented for convert two increased output voltage from single DC input voltage with PWM control technique. Two different output voltage achieved by two different duty cycle. For various dc application normally a single low dc voltage is increased by boost converter and it converted into ac voltage by using inverter finally it used for various dc application. But in this proposed converter no need ac conversion. The converter output voltage is used to two different dc applications without any conversion. Single Input Dual Output Boost converter could be used with PI controller implemented in it to obtain two increased output voltages. The output voltage is obtained as 24V and 48V in the prototype.

The prototype of this converter is developed and the results are compared. This proposed converter is specially designed for hybrid electric vehicles.

REFERENCES

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