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# Multi-Rotor Wind Mill Power Generation System

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**ABSTRACT:**

*The project deals with the details involved in the generation of power through wind with improved technology of multirotor system.. New wind mill power plant should deliver improved features and performance over other existing wind power plants. This paper presents a summary and analysis of wind power plant with greater efficiency and increased power to weight ratio.*

***Keywords (Heading Times New Roman, 12 points, Bold, All caps) HAWT,VAWT, H-bridge,***

## INTRODUCTION:

Energy is the primary and most universal measure of all kinds of work by human beings and nature. Everything that happens in the world is the expression of flow of energy in one of its forms Energy is an important input in all sectors of a country's economy. The standard of living is directly related to per capita energy consumption.

Due to rapid increase in the population and standard of living, we are faced with energy crisis. Conventional sources of energy are increasingly depleted. Hence, non-conventional energy sources have emerged as potential source of energy in India and world at large. Among the various non-conventional energy sources, wind energy is emerging as the potential major source of energy for growth.

Now a day's depletion of fossil fuel reserves and with increasing concern of global warming the whole world is looking at sustainable energy solutions to preserve the earth for the future generations. Day to day the present generation living life style is improved and because of that energy demand is also rising.

To meet these demands alternate fuel is necessary i.e. non-conventional energy sources. The hydro power, wind and photovoltaic energy hold the most potential to meet our energy demands. Wind energy is capable of supplying large amounts of power but its presence is highly unpredictable as it can blow from any direction.

HAWT (Horizontal axis wind turbine) and VAWT (Vertical axis wind turbine) are good media for generating electricity from a clean and renewable resource for our homes and businesses. It comes with a couple of advantages for both humans and the environment. Wind possesses energy by virtue of its motion .Any device capable of slowing down the mass of moving air can extract part of the energy and convert into useful work.

## FEATURES OF HAWT AND VAWT:

As to the Horizontal axis wind turbine, during the process of one circle of rotation of the blades, the blades receive the combined effects of inertial force and gravity. The direction of the inertial force is subject to change, while that of the gravity is stable ever, so that the blades suffer an alternating load, which is very detrimental to the fatigue strength of the blades. Besides, the generator of the Horizontal axis wind turbine is about tens of meters far away from the ground, which brings a lot of troubles to repair and maintain the generator. As to the Vertical axis wind turbine, during the process of rotation of the blades, the condition of receiving effects is better than that of the Horizontal axis wind turbine, because the directions of the inertial force and gravity keep stable ever. Therefore, the blades receive a fixed load, and accordingly the fatigue longevity is longer than the Horizontal axis wind turbine. At the same time, the generator of the Vertical axis wind turbine is often placed under the rotor or on the ground, and so it is easy for repair and maintenance.

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The tip speed ratio of the Horizontal axis wind turbine is generally about 5 to 7.whereas the tip speed ratio of the Vertical axis wind turbine is usually 1.5 to 2. So aerodynamic noise from HAWT (horizontal axis wind turbine) is more than VAWT (vertical axis wind turbine) . In practice noise from VAWT is almost negligible. With small tip speed ratio contamination of the blades is avoided in the case of VAWT.

In this paper we combined both HAWT and VAWT with a gear system. HAWT requires wind sensor whereas Wind direction does not matter much for VAWT because its blade structure is made in such a way that it can start from any position. We will be using H-bridge circuit for wind sensing which is provided with suitable structure to rotate whole of HAWT.

**BLOCK DIAGRAM:**

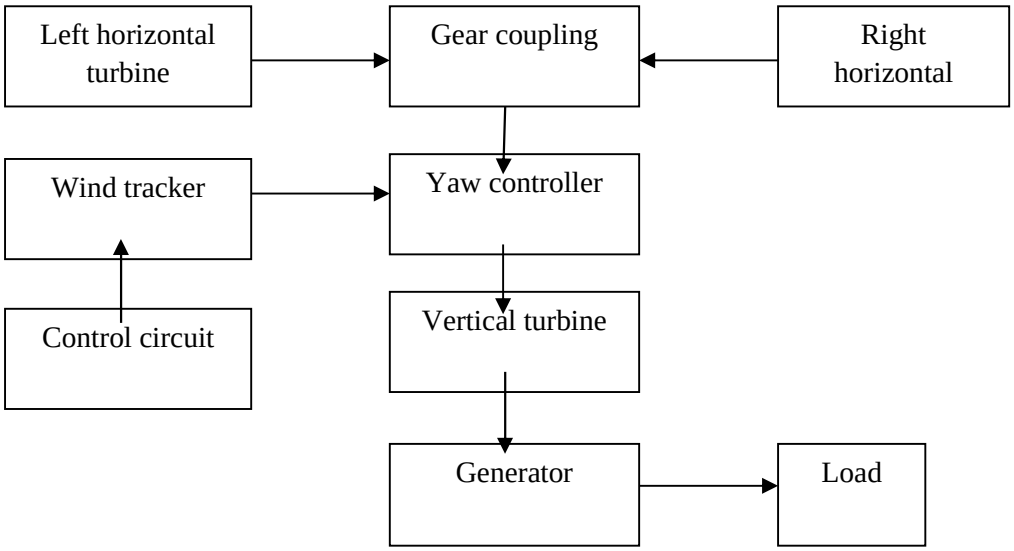


**Fig 1:block diagram**

**HORIZONTAL AXIS WIND TURBINES** in which the axis of the rotor's rotation is parallel to the wind stream and the ground. Most HAWTS are two or three bladed, though some may have fewer or more blades there are two kinds of horizontal axis wind turbines: the upwind wind turbine and the downwind wind turbine.

**VERTICAL AXIS WIND TURBINES** is an old technology, dating back to almost 4,000 years ago. Unlike the HAWT, the rotor of the VAWT rotates vertically around its axis instead of horizontally. VAWT's spin in vertical axis and comes in various shapes, sizes and colors. Its movement is similar to a coin spinning on the edge. There are two different styles of vertical wind turbines out there. One is the Savonius rotor, and the second is the Darrieus model.

**YAW CONTROL** yaw drive consists of an electric motor, a reduction gear and a shaft pinion engaged with a ring gear on the yaw bearing.

**WIND TRACKER SYSTEM** is a tail which is used for the detecting the wind direction. By combination and by incorporating of two rotors (Horizontal and Vertical) the maximum power output can be obtained, which involves wind tracking system. This wind tracking system tracks the wind and hence makes the decision to face the horizontal rotor in the particular direction. Hence the power transfer efficiency and reliability can be improved significantly.

**GEAR COUPLING** is done with both the axis shaft for the rotation purpose. Spur gear is used along vertical and bevel gear along horizontal.

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**GENERATOR** is used to generate electricity whenever the turbines start to rotate and is used to generate electricity continuously for both small and large wind velocity.

**CONTROL CIRCUIT** is an H-bridge circuit which is used for the controlling of dc geared motor and to obtain signals from wind vane and for the working of the turbines whether in clockwise or anticlockwise depending on the direction of wind.

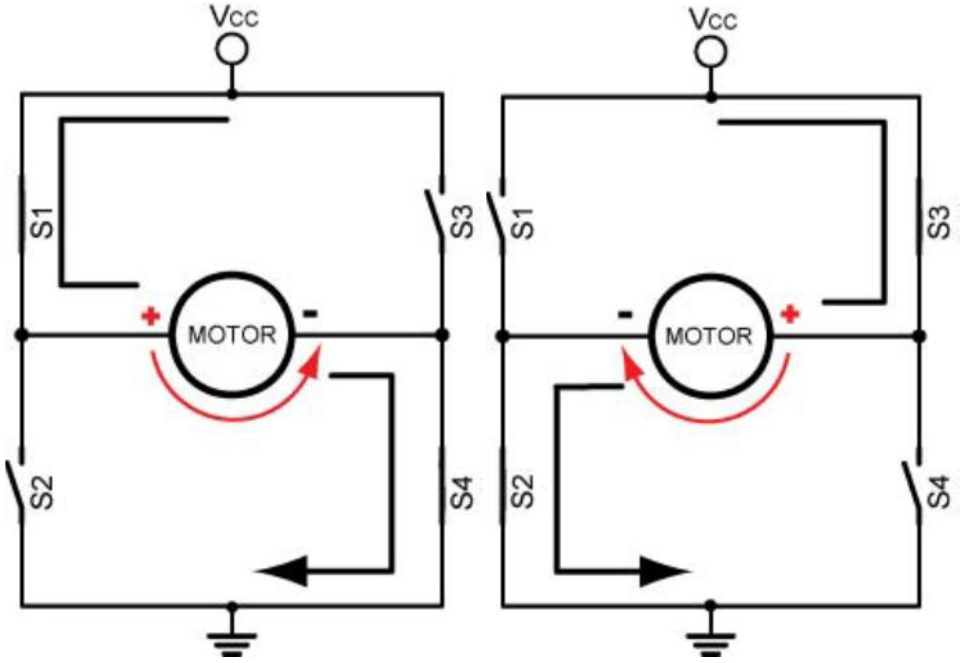


**Fig 2: motor runs in clockwise (switches 1 and 4 closed)**
**Motor runs in anticlockwise (switches 2 and 3 closed)**

**TABLE 1:** H-bridge working table

| CLOSED SWITCHES | OPEN SWITCHES | MOTION |
|---|---|---|
| Nil | S1,S2,S3,S4 | No motion |
| S1,S4 | S2,S3 | Clockwise (say) |
| S2,S3 | S1,S4 | Anti-clockwise |
| S1,S3 | S2,S4 | Brake |

**WORKING OF THE MODEL:**

- When the air flows in a certain speed, with the help of wind sensor HAWT is rotated in the direction of wind. When wind strikes the blades and the blades attached with the rotor starts to rotate.
- If the rotor rotates the power will be transmitted by means of gear (prominently bevel gear) arrangement.
- The power due to horizontal rotation of the shaft will transmit to the vertical shaft here the power get added.
- So that the DC Generator also engages and hence the power is produced.
- The produce electric power can be stored in the battery. The stored power can be utilized for various purposes.

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## SAFETY SYSTEMS FOR WIND TURBINES:

**Vibration Sensors:** During adverse weather conditions, vibration of the turbine can be dangerous for the turbine itself and the parts contained within it. These can range from a very basic mechanical sensor which works by having a ball resting on a ring where the ball is connected to a switch through a chain. If vibrations reach an excessive limit (which can bet set at a required amount), the ball will fall out of the ring which would enable to switch to turn off the turbine.

**Turbine over-speed:** Since the turbine blades would rotate faster with increasing wind speed, it has a safe limit of operation. This limit is set to ensure there would be no blade failure and also protects the components within the nacelle such as generators and gearboxes from overheating and eventual failure. Modern wind turbines are equipped with variable pitch controlled blades where the optimum pitch is constantly selected in order to gain the maximum power output. In an event of high wind speeds, the pitch control would turn the rotor blades 90 degrees (aerodynamic braking). This creates an aerodynamic effect which gently brings the turbine to a stop within a few rotations.

**Thermal and other sensors:** The nacelle of the turbine houses some of the most important components of a turbine. These include the Shaft, Gearbox, Generator, etc. Advanced sensors which monitor the temperature and pressure among many other parameters constantly feed information into the electronic control system of the turbine which would detect any abnormalities and determine if a system shut down is necessary. Overheating can present numerous problems to a turbine because this can lead to fire, additional stress placed on components and bearings, etc.

**Material Failure:** Material selection is extremely important in the design of a wind turbine due to its operating conditions. Testing of this material is also important in order to determine the effects that are present during high levels of loading. Therefore the timely testing and observation to such damage could prevent incidents such as a blade failure, gearbox failure etc.

## FUTURE SCOPE

In this project the HAWT and VAWT is used for the generation of power. The power produced by individual HAWT and VAWT is comparatively less compared to power generated using both HAWT and VAWT. The power electronic controlling circuit is designed for controlling the direction of HAWT blades. Advanced methods like microcontroller, fuzzy logic and artificial neural network can be implemented for designing the controller which can also improve the generation capacity and also power quality. The use of these control methods increases the efficiency, reliability and quality of power generated compared to power electronics controllers.

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