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DEVELOPMENT OF PORTABLE WIND ENERGY SYSTEM

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Structured Abstract-

Purpose: As there is no continuous and proper electricity in the hilly areas, when we go for trekking mountains. There is a need for electricity, this project will help for us by producing electricity.

Methodology: Wind energy conversion systems are designed to convert the energy of wind movement into mechanical power. With wind turbine generators, this mechanical energy converted into electrical energy.

Objective: Check the direction of the wind blowing and also the weather condition, place the equipment in the direction of wind blows.

Findings: The production of electricity is more when the wind is more.

Originality/value: It is pollution free, environment friendly and it is more helpful to everyone.

Abstract – A new design of a portable, inexpensive and easy to assemble horizontal axis wind turbine (HAWT) system for harnessing wind energy that can be reproduced by individuals in the need of electricity has been implemented. The wind speed is at least ranging from 35 to 55 km/h. We conclude that this HAWT is still able to charge some rechargeable energy recharging devices, such as power banks or smart phones. By choosing a wind system to our home, we should consider reducing energy consumption by making our home or business more energy efficient. Reducing our energy consumption will significantly lower our utility bills and will reduce size of the home-based renewable energy system we need.

Keywords: Turbine, Gear box, Generator, Rotor.

1. Introduction:

Wind turbine converts the kinetic energy of the wind into mechanical energy, which is in turn converted to be electrical power. The horizontal axis wind turbine (HAWT) can be visualized as a conventional box fan, in which a set of blades connected to a shaft that is parallel to the ground floor. The rotor blades have to be connected to a horizontal shaft that is connected to a generator which will produce energy from the shaft.

The three main parts of a horizontal axis wind turbine (of our design also follows this pattern, another half follows the HAWT's design below figure 1), namely: rotor which includes the turbine blades, generator such as electrical generator, control electronics, and a gearbox, and structural support including the tower and yaw motor.

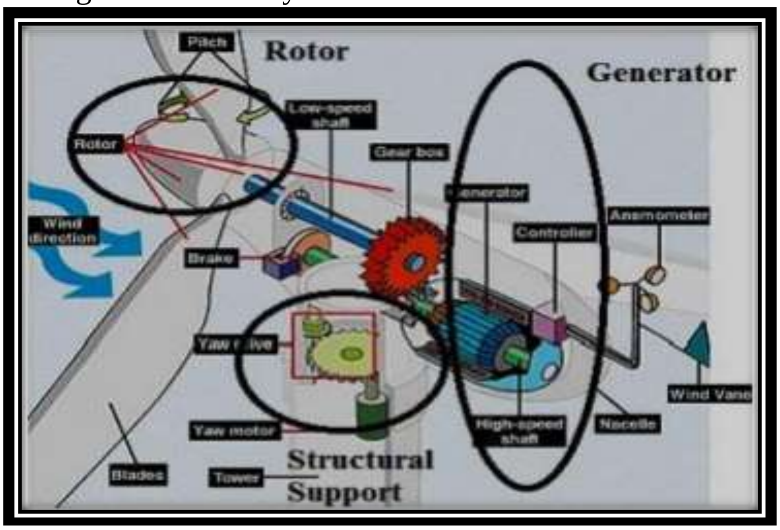

Fig 1: A general pattern of horizontal axis wind system **(HAWT)**

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A general pattern of a horizontal-axis wind turbine (HAWT) which emphasizing its three main parts, generator, and structural support. There are two kinds of HAWTs: the upwind wind turbine and the downwind wind turbine. An upwind rotor faces the wind while a downwind rotor enables the wind to pass the tower and nacelle before it hits the rotor.

Advantages of proposed system:

- Reduces our dependence on fossil fuels
- Not pollutant
- Doesn't disrupt farmland operations

2. Literature survey:

For thousands of years, humans have been using wind as a source for irrigation, water pumping and navigation purposes. People used wind energy to propel boats along the river Nile that can be traced back 5000 years BC. By 200 BC, people in Persia and China were using wooden wind powered water mills for pumping water and grain grinding purposes. These wind mills were of small scale and mostly used for remote areas and minor works.

When power lines were built to transmit electricity, the trend and usage of small wind mills started to decline and remained confined to the rural regions. New ways to use wind energy as a reliable and commercial source of power started around 1990's. In 1903, the Wright Brothers successfully invented the first airplane.

The concept of commercial onshore wind turbines originated from the invention of the airplane. Scientists and researchers were successful in adopting the technology of airplane propeller and wings to the onshore wind energy. The first ever wind turbine was built by the American scientist Charles Bush in 1888.

However, the commercial production of wind turbines begun around 1990's. Initially, due to less development and lack of sophisticated construction technology, production of electricity was only limited to onshore wind turbines. The offshore wind turbines technology evolved from the already developed oil and gas industry.

A lot of modern-day offshore wind turbines structures have been taken from the oil and gas industry like jacket, tri-pileand tripod structures. The first offshore wind farm was built in Denmark in 1991. It was named as Vindeby and operated 1.5 to 3 km off the southern Danish coast. It had 11 windturbines each of 450 kW capacity capable of producing 4.95 MW. Vindeby generated 243 GWh of power in its 26 years life span. Dong Energy decommissioned them in February 2016

Whereas the vertical wind mill is suitable for domestic application and at low cost. The generation of electricity is affected by the geometry and orientation of blades in the wind turbine. To optimize efficiency of VAWT, design parameter of turbine blade plays a vital role The blade and the drag devices are being designed in the ratio of 1:3 to the turbine. The experiment was conducted at different wind speeds and the power produced by the wind turbine is calculated.

Niranjana [1] investigated the power generated by fixing thewind mill on road highways. When the vehicle is moving at high speed then the turbine rotates and generates power. This analysis shows that when the vehicle moves at a speed of 25 m/s then the VAWT is able to produce 1 kW power. The efficiency of the VAWT can be increased by modifying its size and shape of the blade.

Nikam [2] analysed the vertical and horizontal wind mills to produce clean energy. The horizontal wind mill is highly preferred for large scale power production and requiresmassive

The experimental result showed that 567 Watts of electrical power is produced at the speed of 20 m/s while 709 Watts of electrical power is produced at the speed of 25 m/s. Form this investigation it is concluded that increasing the speed of the wind mill, the power production will increase. PiyushGulve[3] observed that VAWT is more efficient than HAWT because it requires compact space for producing same amount of electricity and less noise.

The increased efficiency is achieved based on the characteristics such as aspect ratio, tip speed ratio, velocity and other geometry parameter. The experiment is conducted mainly to increase the power production and efficiency of the turbine. The development of the design is optimized by combining the blade structure and the flow performance. The result obtained indicates that the efficiency of turbine is always based on the wind speed and also the climatic conditions.

He proposed a roof-mounted internal wind turbine that will harness the wind energy when the vehicle is in motion and causes rotation of the shaft of an electric generator mounted to the interior surface of the roof and also an external wind turbine is attached to the internal wind turbine in which, the cups that are used in cup anemometers are attached to the radial arms that extend from an external shaft of the external wind turbine to harness wind currents when vehicle is parked, causing the external shaft and the generator shaft to rotate.

Koo Hui Yee [4] investigated the design of small scale VAWT which is economical and also affordable to the consumers to harness the wind energy to produce small scale electricity. It can be used in rural areas to improve the living condition of the people with a low costelectricity generation.

3. COMPONENTS USED IN THIS SYSTEM:

3.1 PMDC GENERATOR

Permanent magnet DC generator is a kind of power generation device which transforms mechanical energy into electrical energy. It is a kind of permanent magnet DC generator with double permanent magnet and double winding structure.

3.2 DC REGULATOR

A DC Voltage Regulator is a device which maintains the output voltage of an ordinary power supply constant irrespective of load variations.

3.3 BATTERY

An **electric-vehicle battery** (**EVB**, also known as a **traction battery**) is a battery used to power the electric motors of a battery electric vehicle (BEV) or hybrid electric vehicle (HEV).

3.4 LITHIUM-ION BATTERIES

Lithium-ion (and the mechanistically similar lithium polymer) batteries, were initially developed and commercialized for use in laptops and consumer electronics. With their high energy density and long cycle life they have become the leading battery type for use in EVs.

3.5 BATTERY CAPACITY

Non–plug-in hybrid cars have battery capacities between 0.65 kWh (2012)Honda Civic Hybrid) and 1.8 kWh (2001 Toyota Prius). Plug-in hybrid cars have battery capacities between 4.4 kWh (2012 Toyota prius)(Plug-in Hybrid) and 34 kWh (Polestar 1).

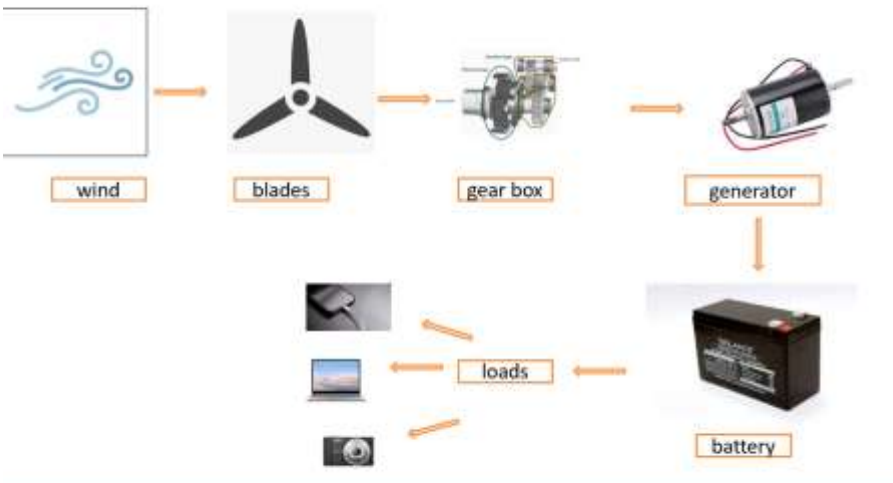

Fig 2: flow chart of flow of energy and components in it

3.6 GEAR BOX

Purpose of the gearbox is to increase the rpm (revolutions per minute). The blades rotate very, very slowly. It is also important to mention that the longest the blade, the lower is the tip speed of the blade: you do not want to increase it to avoid generating noise and to lower the loads on the blade itself.

4. PROPOSED METHODOLOGY

As this research work brought novelty in terms of technology, there was a need to propose its design on the basis of a new analysis to be conducted. Thus, first of all,software Based simulations were used to make decisions regarding the hardware of the system. After this, the complete schematic was designed and the hardware was implemented. The components were connected in accordance with the proposed schematic. First of all, the windturbine, whose output is given to the DC voltage regulator, has the current and voltage sensors on its input and output. The output of the DC voltage regulator is connected to the battery with a protection circuitry in its way.

This protection circuitry is used to protect the battery from overcharging and low charging, by switching the circuit ON and OFF at suitable times.

From kinematics of solid motion, v2 =u 2 +2as where uis the initial velocity of the object. This implies that a=v 2 −u 2 /2s. Assuming the initial velocity of the object is zero, we have that a=v22s.we know that

E=1/2mv2.

MATHEMATICAL DERIVATION

Here we see the how much electrical energy is generated by using mathematical expression. Let us see the mathematical derivation in detail: Under constant acceleration a,the kinetic energy of an object having mass m, and velocity v, is equal to the work done W, in displacing that object from rest to a distance under a force F such that,

E=W=Fs.

According to newton’s second law of motion.

F=ma

the kinetic energy becomes E=ma

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P=de/dt =1/2 dm/dt v2w

But mass flow rate dm/dt is given by dm/dt =ρ*A*v*w where Ais the area through which the wind in this case is flowing and ρis the density of air. With this expression, equation becomes

P=1/2ρAv3w

The actual mechanical power Pw extracted by the rotor blades in watts is the difference between the upstream and the downstream wind powers, i.e.

Pw=1/2ρAvw(v2 u−v 2 d)

Wind Power

In the air traveling with some velocity will exert kinetic energy on the turbine. Thus, by using Equation, the kinetic energy (KE) of the system can be calculated, and now the turbine power generated from air depends upon the mass flow rate of air which is expressed using formula—where ρ is the density of air, A is the area of the cross-section of turbine, and vs. is the air velocity.the formula for the power generated by the turbine via wind power is given in equation, where PR is the turbine power and CP is the power coefficient for the turbine:

Kinetic energy=1/2 mv2 M = ρ*A*v

Kinetic energy =1/2ρAv3

PR =1/2CpρAv3

Mechanical Power

In order to find the shaft power, the first thing we need to determine is the shaft power coefficient. For this, we first need to determine the tip-to-speed ratio of the shaft which is determined by the formula:

A = 4π/B

Where B = 7 is the number of blades:

$A = 4\pi/7$
$= 1.795$
A = 1.795 correlates to a power coefficient Cp = 0.13.
With an augmentation of 0.2, CPs= 0.13 + 0.21 = 0.34, where CPs is the shaft power coefficient. Now, the mechanical power is equal to the shaft power that is:
Pmech = Ps = CPsPw =1/2Cps$r$Av3
For the turbine diameter of 0.36 m, the area of the turbine is determined by the
Formula

Electrical Power= d2 /4

The shaft power induced in the shaft of the generator is
transmitted to the generator for the induction process.
The w can be calculated by
the formula given in equation, where R is the length of the fan blade:
Pe=1/2 $\eta\rho$Av3
Ps = Tw =) T =Psω
ω =λv/R

Force Calculation

The force acting on the fan to operate is the difference between the two forces acting on it. One is the lift force (FL), exerted by the air
to rotate the fan expressed in Equation:
FL =1/2 CLρV2At
but for every action, an opposite reaction is present. In this case, an opposite force emerges, which tries to restrict the fan from moving. This force is called drag force and is calculated by the following formula in Equation:
FD =1/2CDρV2At
where CL and CD are the lift coefficient and drag coefficient, respectively, and at the fan surface area. Now, the total force on the fan is the vectorial sum of both forces, meaning that:
F = FL cos(90 - ϕ) - FD sin(90 -ϕ)

5.CONCLUSION & FUTURE SCOPE:

This paper proposes a wind turbine which is portable anywhere and set up at any place, anywhere to produce electricity by wind energy. The electricity which generated is completely pollution free and it doesn't have any impact on the environment. The speed of wind increases output power. — wind has the cubic relationship with the power, as wind speed double, power output increases by eight times.

The wind blow is not same throughout the whole day and we proposed that the blades of turbine are small so in order to have a efficient output , we have to estimate carefully on the shape, size of the blades of the turbine to generate electricity This generated electricity is stored in a inbuilt battery and used as an alternative source to charge electronic gadgets i.e. mobiles ,laptops, drones, cameras etc It is the ultra -compact, highly efficient, portable(1 litre bottle sized) wind turbine that lets us to use the wind to rapidly create clean power to charge all our handled devices. It all we need only 2 minutes to set up it anywhere.it has capable of generating 40 watts.it saves the power on its 1200mAh internal lithium-ion battery for later use. From this portable turbine we are able to generate more power for less weight which is has weight of 3 pounds and optimized its blades for maximum power.it can generate power at night and on cloudy day well. The efficiency of wind power with this turbine gives the highest power to weight compared to other portable renewable energy devices including solar panels, water turbine. this means we are getting the most power for the least amount of weight we have to carry.it is super lightweight. It delivers all benefits of large turbine scaled down to fit in our backpack. The main conclusion of this project is to create rapid clean efficient portable wind energy day and night whenever wind blow.

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The increasing demand for clean and affordable energy all over the world will without doubt lead to an increasing demand for small wind. In particular in the developing countries, small wind can easily and fast contribute to electrify millions of people in rural areas. Wind energy is renewable sources so we have to generate power for long period. Wind energy independent from climate condition. So generating the power for any time.

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