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Harvesting of energy at high altitude by aloft Wind Turbine

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Abstract: **presently Bangalore is facing problem w r t power shortage, reason is hydropower plant dams are not getting sufficient rain fall in the monsoon. But in the outskirts ceaseless wind with high velocity at altitude of 800m to 900m from the mean earth surface. High altitude wind is powerful and that has another important advantage, it is stable and constant. This is true practically everywhere. This paper suggests a revolutionary innovation which produces a dramatic increase in power per unit and is independent of prevailing weather and at a lower cost per unit of energy extracted. The main innovation consists of large free-flying air rotors along with electrical generator positioned at high altitude 1000m, locked with help of cable. Wind speed varies from 11.4 to 15m/s estimated maximum output power is 63MW.**

Key words: cable, wind speed at high altitude, air rotor

I. Introduction

Bangalore is one of the fastest growing cities in India and is branded as 'Silicon Valley of India'. The city enjoys a pleasant and salubrious climate throughout the year.
Wind energy is one of the most popular renewable energies in the world. However, the generation of a strong and steady wind flow is not easy to achieve. The revolutionary innovation which produces a dramatic increase in power per unit and is independent of prevailing weather and at a lower cost per unit of energy extracted. The main innovation consists of large free-flying air rotors positioned at high altitude for power and air stream stability, conversion of energy from one form to another with help of small size generator which is placed along with aloft turbine which is DNA shape at high altitude. Electrical energy distribution is taken at ground level with help of transformer other elements.

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II. Description

A. *Geography*

Bangalore, the capital of Karnataka State with an average annual growth rate of 3.25 % and population of 8.4 Million (census 2011) and area of 800 sq km. Bangalore is located at 12^0, 50' North Latitude and 77^0, 57' East longitude with an altitude of 920m above MSL. Bangalore usually enjoys a more moderate climate throughout the year. The mean annual total rain fall is about 970 mm. The coolest month is January with an average low temperature of 15.1 °C and the hottest month is April with an average high temperature of 33.6 °C. The highest temperature ever recorded in Bangalore is 38.9°C and the lowest ever is 7.8 °C (on January 1884).

B. *Wind*

Wind is a clean and inexhaustible source of energy that has been used for many centuries to grind grain, pump water, propel sailing ships, and perform other work. Winds originate from the subtropical high-pressure belt of the northern hemisphere. After that, these winds blow towards south. They get deflected to the right due to the Coriolis force and then move towards the low pressure area near the equator. These winds blow mainly from the directions between the south – west and north – west during the south – west monsoon season. In the post monsoon season, wind blows mainly in the north easterly or easterly direction. During the rest of the year, wind blows from the direction between north and east. The maximum normal wind speed recorded at Bangalore is 5 m/s in the months of May and July at ground surface.

C. *Turbine*

The present project is focusing on horizontal axis oval shape balloon is used as a turbine with special constructional feature along with Helix shape Vertical Axis Wind Turbine (VAWT) rotor is currently under designing process. This design is currently unproven on a megawatt scale, requiring several experiments to evaluate the performance at high altitude with high wind velocity, before it can be considered competitive. In addition to the problems associated with alternative designs.

D. Balloon

Theorem Any object submerged in a fluid will have a buoyant force upward applied to it by the pressure difference of the surrounding fluid, between the top and the bottom of the object. The object will also have a force downward on it due to gravity, called its weight. Same way helium gas filled balloon is flies due to density difference between gas inside the balloon and air present in atmosphere. Oval shape balloon is specially designed with dimension of 10m length and 4m dia with thickness of 5mm. made from elastic material.

III. Conceptualization

Conventional pole type wind turbine having some of the major drawbacks like high initial investment cost, mounting of blades at high altitude is risky, maintaince, adverse effect on birds life, visually detract from the landscape, more noise. Initially aloft wind turbine techniques is conceptualized by observing the hot air balloon, which are having lifting capacity of 3 to 4 persons due to difference in air density. First hot air developed by the Montgolfier brothers of France in 1783.but hot air balloon air inside the envelop is continuously heated from by burning the fossil fuels in order to keep the air density low as possible.

Main advantages of Horizontal axis wind turbine, it is not experience the Coriolis force when it's rotating at high speed due to constant wind speed. Coriolis force is purely depending blade profile and fluctuation in wind velocity.

Extra up-lifting force of helium gas balloon is used by attaching Vertical axis turbine to then locking thread. Wind power is a function of the cube of wind velocity. At surface level, wind has low speed and its non-steady. If wind velocity decreases in half, the wind power decreases by a factor of 8 times.

A. Model

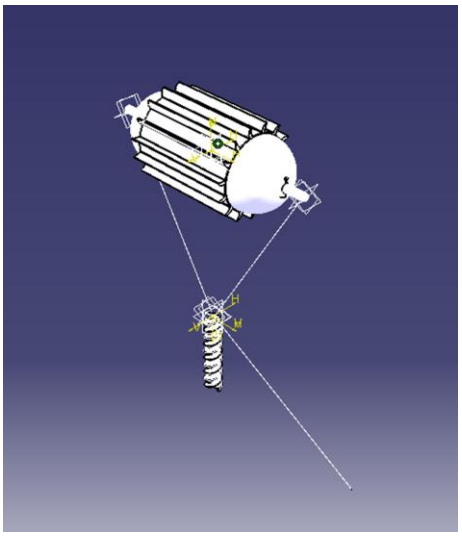

Figure 1. Conceptualized model

Table1. Bill of material for model

slno	Description	Material	no
1	Helium balloon	Latex	1
2	Helix (DNA)	Al Alloy	1
3	Al shaft	Al alloy	2
4	Rope	Polypropylene	1
5	Bearing	brass	4
6	Alternator	-	2

B. Equations

Estimation of wind velocity at high altitude wind speeds were determined considering the characteristics of the rotor.The wind profile power law defines the relationship between wind speeds at two different heights. This law is often used in wind power assessments. The following equation expresses the profile of wind speeds with reference to the altitude (Wikipedia, 2011a).

$$V/V_o=(H/H_o)^{\alpha}$$

Where, v is the wind speed and h is the altitude. The exponent α value is an empirically derived coefficient that varies depending on the stability of the atmosphere. For neutral stability conditions, α is approximately 0.25. Although wind conditions vary with regional differences, the profile pattern remains almost similar. This means that wind power becomes approximately 2.7 times at 500 m height compared with that at 50 m height.

c. Power calculation:

Power increases with altitude as the cube of wind speed

$$N=(H/H_o)^{3\alpha}N_O$$

where N_o is power at H_o. H expected height of the turbine

.The drag of the rotor equals

$$Dr=N/V$$

The lift force of the wing, *Ly*, is

$$Ly=0.5C_L\rho V^2Aw\ ,\ Ly=W$$

Where C_L is lift coefficient (maximum C_L = 2.5), A_w is area of the wing, W is weight of installation +0.5weight of all cables. The drag of the wing is

$$D = 0.5C_D\rho V_2A_w,$$

Where C_D is the drag coefficient (maximum C_D =1.2).

Power produced by the conceptualized model is estimated by using the fallowing equation is as follows:

Power of a wind energy *N* [Watt, Joule/sec]

$$N=0.5\rho\eta AV^3 \quad \text{Watts}$$

The coefficient of efficiency,η , equals 0.15-0.35 for low speed rotors η = 0.35-0.5 for high speed rotors (λ= 5-7). The Darrieus rotor has η = 0.35- 0.4. The propeller rotor has η = 0.45-0.50. The theoretical maximum equals η= 0.67.

IV. Cost estimation

Balloon material: total volume of the balloon material is need to produce required size with thickness of 5mm is 0.550125m^3 With density of 980kg/m^3,
Total weight of the balloon is 55kg.
Cost of the balloon material per kg is 500 INR supplied from rubber board ministry of the commerce and industry Govt of India. Kottayam, Kerala.
Total cost of the balloon is: 27500 INR,

Helix Material: total weight of the helix is estimated 8 kg from the empirical relationship of density and total volume.
Cost of the selected aluminum alloy 7075 material: 1800 INR supplied from the nansenon pvt limited.
Total cost helix is: 14400 INR.

Al shaft: material made from aluminum alloy having physical dimension of 400mm dia 10mtr long, cost of 2000 INR.

Rope material: rope is used to lock the balloon to position at the required height with respect to direction of the wind blowing, the rope is made of low density plastic material in order reduce the drag on the turbine balloon.
Material used to manufacture the rope is polypropylene with low density of total length of the rope required is 1200meter to positioning the rope dia meter is 60mm.
Total weight of the rope is 102kg.
Cost of the rope is estimated is: 10000 INR

Bearing: large diameter bearing is supplied by national engineering industries limited. Khatipura road hasanpur, near city railway station Jaipur. India. With cost of 500 INR

Alternator: it's supplied by Wuxi Nai Er Wind Power Technology Development limited. The total weight of the alternator is 20kg,it operate up to 16m/s wind velocity of the . the expected cost of the alternator is 40000 INR .the technical specification of the alternator are given below:

Table2. Alternator specification

Model number:	NE-1000
Rated Output Power	1000 W
Outer frame material	High standard Aluminum alloy
Outer frame finish	Al urface is anodised then power painted
Weight(Kgs)	18
Windings temp rating	180 degrees
Generator	3 Phase AC output
Starting torque(NM)	<1.5

Anemometer: Along with the above major components Anemometer is used to measure the actually wind velocity and direction of the wind at a specified location
The cost of the anemometer is 12000 INR.

Table3 overall cost of the major components

Components	**Expected cost**
Balloon	27500
Helix	14400
Al Shaft	2500
Rope	10000
Alternator	40000
Anemometer	12000
Total	**106400 INR**

V. Conclusion

The preliminary study about high-altitude balloon wind power generation system in this article shows that it is possible to obtain much more wind energy.
Conventional windmills are approached their maximum energy extraction potential relative to their Installation cost. No relatively progress has been made in windmill technology in the last 50 years. The wind energy is free, but its production more expensive than its production in thermal power station. Current wind installations cannot essential decrease a cost of kWh, The renewable energy industry needs revolutionary ideas that improve performance parameters (installation cost and power per unit) and that significantly decreases (in 10-20 times) the cost of energy production. This concept offers ideas that can move the wind energy industry from stagnation to revolutionary potential with helium gas balloon technique, the fallowing expected significant changes are listed below.

1. The produced energy at least in 10 times cheaper then energy received of all conventional electric or Hydro power stations includes current wind installation.
2. The proposed system is relatively inexpensive (no expensive tower and installation), it can be made with a very large thus capturing wind energy from an enormous area (hundreds of times more than typical wind turbines).
3. The power per unit of proposed system in some hundreds times more of typical current wind
4. Installations.
5. The proposed installation not requires large ground space like tower wind turbine.
6. No noise and bad views.
7. The energy production is more stability because the wind is steadier at high altitude. The wind may be zero near the surface but it is typically strong and steady at higher altitudes.

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